j.c. brennan & associates
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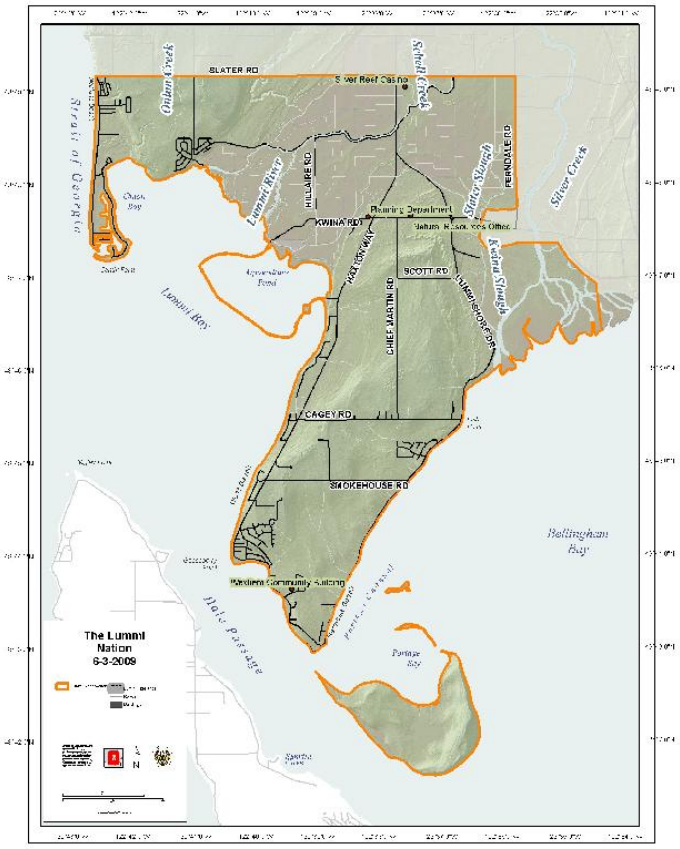
Background Noise Report
Contract # 166-10
August 2011



Prepared for:

Lummi Nation
Natural Resources Department
Program Manager: Jeremy Freimund
2616 Kwina Road
Bellingham, WA 98226

LUMMI NATION
TREATY OF 1855

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j.c. brennan & associates
consultants in acoustics
P.O. Box 6748 • Auburn, California 95604
263 Nevada Street • Auburn, California 95603
p.530.823.0960 • f.530.823.0961 • www.jcbrennanassoc.com

August 3, 2011

Mr. Jeremy Freimund
Lummi Indian Natural Resources Department
2616 Kwina Road
Bellingham, WA 98226

Subject: Submittal of the Ambient Noise Survey and Noise Prediction Model Calibration Results for the Lummi Nation Wind Turbine Feasibility Study

Dear Jeremy,

Attached you will find the ambient noise survey and noise prediction model calibration results for the Lummi Nation Wind Turbine Feasibility Study. An original bound copy is being sent via mail.

Please feel free to contact me if you have questions.

Respectfully submitted,

j.c. brennan & associates, Inc.

Jim Brennan
President
Member: Institute of Noise Control Engineering

EXECUTIVE SUMMARY

The following provides the results of the ambient noise survey for the Lummi Reservation Wind Turbine Feasibility Study. To quantify the existing ambient noise environment in the project vicinity, four (4) continuous hourly noise level monitoring sites were identified, and four (4) short-term noise level measurement sites were identified. Each of the sites, with the exception of one site, represents noise sensitive areas, such as residential and hotel land uses. One of the continuous hourly noise measurement sites (Site LT-2) was located at the Smokehouse Road meteorological tower to assist in establishing background noise to measured wind speed. The continuous hourly noise measurements were conducted for a period between six (6) and seven (7) days. In addition, infrasound measurements were conducted at each of the short-term noise measurement sites.

The results of the ambient noise survey indicate that overall background noise levels are low. The area can generally be characterized as a quiet noise environment, and consistent with a rural area. The noise measurement data will be used for a comparison to potential wind turbine noise levels which will be determined at a later date.

Infrasound noise, or very low frequency noise in the 1 Hz to 20 Hz range were also measured for short periods of time (approximately 10 to 15 minutes). The infrasound measurements indicated that some infrasound is currently present in the area, and is generally due to distant roadway traffic. The infrasound noise measurements were conducted in the early morning hours of April 20th, 2011. There were light winds during the measurement period, and therefore, existing infrasound noise levels were low. Generally, when winds range between 10 and 15 mph, measured infrasound levels can be expected to be significantly higher than those which were measured during the morning of April 20th.

This analysis also provided a calibration of the CadnaA Noise Prediction Model which will be used to predict wind turbine noise levels. The calibration process is described in detail later in this report. The results indicated that the CadnaA Noise Prediction Model was accurate within 1.5 dBA at the noise monitoring locations used in the calibration process.

INTRODUCTION

The Lummi Nation Natural Resources Department has contracted with j.c. brennan & associates, Inc. to conduct an analysis of wind turbine noise impacts associated with the potential construction and operation of wind turbine arrays on the Lummi Nation Reservation. As a part of the contract, a Setting Document which describes the ambient noise environment within the Lummi Nation Reservation has been included in the scope of services to be provided by j.c. brennan & associates, Inc. The following describes the ambient noise environment, as well as a calibration of the noise prediction model proposed to be used for evaluating the wind turbine noise impacts.

The first step in assessing potential noise impacts is to conduct ambient noise measurements at noise sensitive receptors. The intent of the noise measurements is to establish the noise environment while accounting for existing noise-producing uses such as traffic noise, tsunami warning signals, and the affects of ambient noise from wind.

BACKGROUND INFORMATION ON NOISE

Fundamentals of Acoustics

Acoustics is the science of sound. Sound may be thought of as mechanical energy of a vibrating object transmitted by pressure waves through a medium to human (or animal) ears. If the pressure variations occur frequently enough (at least 20 times per second), then they can be heard and are called sound. The number of pressure variations per second is called the frequency of sound, and is expressed as cycles per second or Hertz (Hz).

Noise is a subjective reaction to different types of sounds. Noise is typically defined as (airborne) sound that is loud, unpleasant, unexpected or undesired, and may therefore be classified as a more specific group of sounds. Perceptions of sound and noise are highly subjective from person to person.

Measuring sound directly in terms of pressure would require a very large and awkward range of numbers. To avoid this, the decibel scale was devised. The decibel scale uses the hearing threshold (20 micropascals), as a point of reference, defined as 0 dB. Other sound pressures are then compared to this reference pressure, and the logarithm is taken to keep the numbers in a practical range. The decibel scale allows a million-fold increase in pressure to be expressed as 120 dB, and changes in levels (dB) correspond closely to human perception of relative loudness.

The perceived loudness of sounds is dependent upon many factors, including sound pressure level and frequency content. However, within the usual range of environmental noise levels, perception of loudness is relatively predictable, and can be approximated by A-weighted sound levels.

There is a strong correlation between A-weighted sound levels (expressed as dBA) and the way the human ear perceives sound. For this reason, the A-weighted sound level has become the standard tool of environmental noise assessment. All noise levels reported in this section are in terms of A-weighted levels, but are expressed as dB, unless otherwise noted.

The decibel scale is logarithmic, not linear. In other words, two sound levels 10 dB apart differ in acoustic energy by a factor of 10. When the standard logarithmic decibel is A-weighted, an increase of 10 dBA is generally perceived as a doubling in loudness. For example, a 70 dBA sound is half as loud as an 80 dBA sound, and twice as loud as a 60 dBA sound.

Community noise is commonly described in terms of the ambient noise level, which is defined as the all-encompassing noise level associated with a given environment. A common statistical tool to measure the ambient noise level is the average, or equivalent, sound level (L_{eq}), which corresponds to a steady-state A-weighted sound level containing the same total energy as a time varying signal over a given time period (usually one hour). The L_{eq} is the foundation of the composite noise descriptor, L_{dn}, and shows very good correlation with community response to noise. The L(n) is the sound level exceeding a described percentile over a measurement period. For instance, an hourly L50 is the sound level exceeded 50% of the time during the one hour period.

The day/night average level (L_{dn}) is based upon the average noise level over a 24-hour day, with a +10 decibel weighing applied to noise occurring during nighttime (10:00 p.m. to 7:00 a.m.) hours. The nighttime penalty is based upon the assumption that people react to nighttime noise exposures as though they were twice as loud as daytime exposures. Because L_{dn} represents a 24-hour average, it tends to disguise short-term variations in the noise environment. Table 1 lists several examples of the noise levels associated with common noise sources. Appendix A provides a summary of acoustical terms used in this report.

Effects of Noise on People

The effects of noise on people can be placed in three categories:

- Subjective effects of annoyance, nuisance, and dissatisfaction
- Interference with activities such as speech, sleep, and learning
- Physiological effects such as hearing loss or sudden startling

Environmental noise typically produces effects in the first two categories. Workers in industrial plants can experience noise in the last category. There is no completely satisfactory way to measure the subjective effects of noise or the corresponding reactions of annoyance and dissatisfaction. A wide variation in individual thresholds of annoyance exists and different tolerances to noise tend to develop based on an individual's past experiences with noise.

Thus, an important way of predicting a human reaction to a new noise environment is the way it compares to the existing environment to which one has adapted: the so-called ambient noise level. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be judged by those hearing it.

Table 1
Typical Maximum Noise Levels

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	--110--	Rock Band
Jet Fly-over at 300 m (1,000 ft)	--100--	
Gas Lawn Mower at 1 m (3 ft)	--90--	
Diesel Truck at 15 m (50 ft), at 80 km/hr (50 mph)	--80--	Food Blender at 1 m (3 ft) Garbage Disposal at 1 m (3 ft)
Noisy Urban Area, Daytime Gas Lawn Mower, 30 m (100 ft)	--70--	Vacuum Cleaner at 3 m (10 ft)
Commercial Area Heavy Traffic at 90 m (300 ft)	--60--	Normal Speech at 1 m (3 ft)
Quiet Urban Daytime	--50--	Large Business Office Dishwasher in Next Room
Quiet Urban Nighttime	--40--	Theater, Large Conference Room (Background)
Quiet Suburban Nighttime	--30--	Library
Quiet Rural Nighttime	--20--	Bedroom at Night, Concert Hall (Background)
	--10--	Broadcast/Recording Studio
Lowest Threshold of Human Hearing	--0--	Lowest Threshold of Human Hearing

Source:Caltrans, Technical Noise Supplement, Traffic Noise Analysis Protocol. October 2009.

With regard to increases in A-weighted noise level, the following relationships occur:

- Except in carefully controlled laboratory experiments, a change of 1 dBA cannot be perceived;
- Outside of the laboratory, a 3 dBA change is considered a just-perceivable difference;
- A change in level of at least 5 dBA is required before any noticeable change in human response would be expected; and
- A 10 dBA change is subjectively heard as approximately a doubling in loudness, and can cause an adverse response.

Stationary point sources of noise – including stationary mobile sources such as idling vehicles – attenuate (lessen) at a rate of approximately 6 dB per doubling of distance from the source, depending on environmental conditions (i.e. atmospheric conditions and either vegetative or manufactured noise barriers, etc.). Widely distributed noises, such as a large industrial facility spread over many acres, or a street with moving vehicles, would typically attenuate at a lower rate.

Infrasound Noise Levels

Infrasound and low frequency sound are subjects of current controversy with regards to residents living in proximity to proposed wind turbine projects. As described earlier, infrasound is considered to be in the 1Hz to 20 Hz range. Low frequency sound is considered to be in the 10 Hz to 200 Hz range. The audibility of sound in the infrasound and low frequency sound ranges should be discussed. The human ear and a person's ability to hear sound at low frequencies becomes more difficult in these frequencies. The human ear's acuteness at hearing sound decreases as the frequencies decrease. Table 2 shows hearing threshold for sound in the infrasound and low frequency sound ranges for young healthy individuals.

Table 2 Hearing Thresholds in the Infrasound and Low Frequency Ranges													
Frequency (Hz)	4	8	10	16	20	25	40	50	80	100	125	160	200
Sound Pressure (dB)	107	100	97	88	79	69	51	44	32	27	22	18	14
Source: Leventhall et al., 2003													

Infrasound is generally always present in the environment. Infrasound can be associated with many sources including ambient air turbulence or wind, distant aircraft or roadway traffic, and wave action on a sea shore. The human respiratory, circulatory and digestive systems all emit internal infrasound. A person's heart beats at a frequency of 1 to 2 Hz. The most common source of infrasound is vehicular.

Based upon research from 2002 to 2006, conducted by the Renewable Energy Research Laboratory at the University of Massachusetts at Amherst, Department of Mechanical and Industrial Engineering, the following conclusions are provided:

"The primary human response to perceived infrasound is annoyance, with resulting secondary effects. Annoyance levels typically depend on other characteristics of infrasound, including intensity, and variations in time. Infrasound has three annoyance mechanisms:

- *A feeling of static pressure*
- *Periodic masking effects in the medium and higher frequencies*
- *Rattling of doors, windows, etc. from strong low frequency components*

Human effects vary by the intensity of the perceived infrasound, which can be grouped in these approximate ranges:

- *90 dB and below: No evidence of adverse effects*
- *115 dB: Fatigue, apathy, abdominal symptoms, hypertension in some humans*
- *120 dB: Approximate threshold of pain at 10 Hz*
- *120 – 130 dB and above: Exposure to 24 hours causes physiological damage"*

To place infrasound into perspective, when a child is swinging high on a swing, the pressure change on its ears, from top to bottom of the swing, is nearly 120 dB at a frequency of around 1 Hz."

"There is no reliable evidence that infrasound below the perception threshold produces physiological or psychological effects."

(*Source: Wind Turbine Acoustic Noise, A White Paper, Prepared by: Renewable Energy Research Laboratory Department of Mechanical and Industrial Engineering, University of Massachusetts at Amherst, June 2002 Amended January 2006*).

REGULATORY SETTING

U.S. Environmental Protection Agency

In response to the Federal Noise Control Act of 1972, the U.S. Environmental Protection Agency (EPA) has identified noise levels requisite to protect public health and welfare against hearing loss, annoyance and activity interference (EPA 1974). The EPA recommended criteria are shown in Table 3.

The document (EPA 1974) identifies a 24-hour exposure level of 70 A-weighted decibel (dBA) as the level of environmental noise which would prevent any measurable hearing loss over a lifetime. Likewise, levels of 55 dBA outdoors and 45 dBA indoors are identified as preventing activity interference and annoyance. These levels of noise are considered those which will permit spoken conversation and other activities such as sleeping, working and recreation, which are part of the daily human condition. The levels are not single event, or "peak" levels. Instead, they represent averages of acoustic energy over periods of time such as 8 or 24 hours, and over even longer periods of time (e.g., years).

Table 3
Summary of Noise Levels Identified as Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety

Effect	Level dBA[1]	Activity Area
Hearing Loss	70 L_{eq} (24-hour)	All areas
Outdoor Activity Interference and Annoyance	55 L_{dn}[2]	Outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use
	55 L_{eq} (24-hour)[3]	Outdoor areas where people spend limited amounts of time (e.g., school yards, playgrounds)
Indoor Activity Interference and Annoyance	45 L_{dn}[2]	Indoor residential areas
	45 L_{eq} (24-hour)[3]	Other indoor areas with human activities (e.g., school yards playgrounds)

Source: EPA 1974
[1] A-weighted decibel (dBA) is a measure on a logarithmic scale which indicates the squared ratio of sound pressure to a reference sound pressure.
A-weighted (A) refers to the specific frequency-dependent rating scale that is used to approximate human response.
[2] Day-Night Level (L_{dn}) is the energy-average of the A-weighted noise levels during a 24-hour period with 10 dBA added to the night (10 p.m. to 7 a.m.) hours.
[3] Equivalent Noise Level (L_{eq} is the energy mean (average) noise level. The instantaneous noise levels during a specific period of time (e.g., 24 hour) in dBA are converted to relative energy values. From the sum of the relative energy values, an average energy value is calculated, which is then converted back to dBA to determine the 24-hour L_{eq}.

Lummi Nation Noise Level Criteria

The Lummi Nation does not have noise level criteria which addresses project-related noise sources.

PHYSICAL SETTING

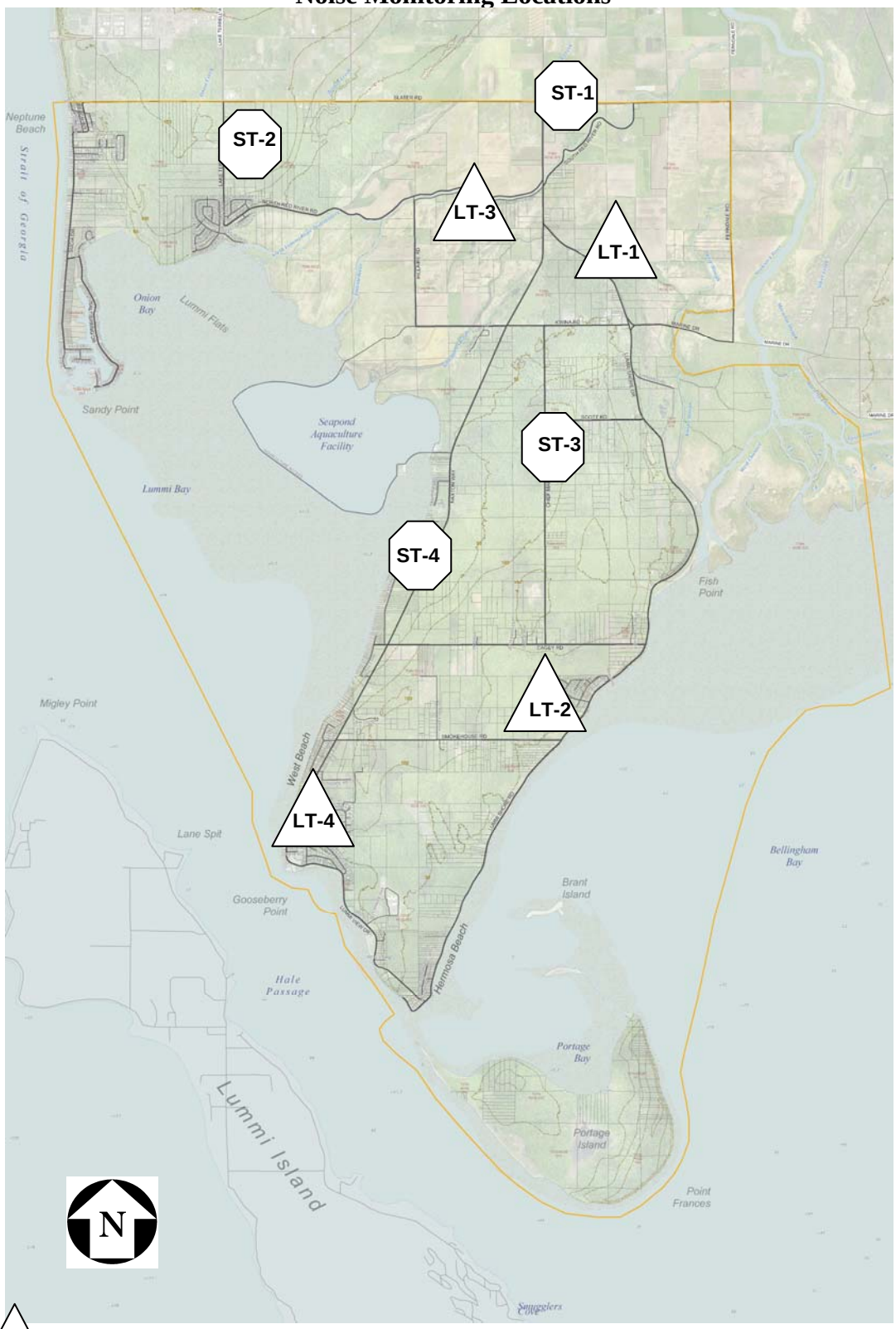
Existing Noise Environment in Project Vicinity

To quantify the existing ambient noise environment in the project vicinity, four (4) continuous hourly noise level monitoring sites were identified, and four (4) short-term noise level measurement sites were identified. Each of the sites, with the exception of one site, represents noise sensitive areas, such as residential and hotel land uses. One of the continuous hourly noise measurement sites (Site LT-2) was located at the Smokehouse Road meteorological tower to assist in establishing background noise to measured wind speed. The continuous hourly noise measurements were conducted for a period between six (6) and seven (7) days. In addition, infrasound measurements were conducted at each of the short-term noise measurement sites.

The continuous or long-term (LT) sound level meters were programmed to record the hourly maximum (Lmax), median (L_{50}), L_8, and average (L_{eq}) noise levels at each site during the survey. The maximum value, denoted L_{max}, represents the highest noise level measured. The average value, denoted L_{eq}, represents the energy average of all of the noise received by the sound level meter microphone during the monitoring interval periods. The median value, denoted L_{50}, represents the sound level exceeded 50 percent of the time during the monitoring period. The L_8 value represents the sound level exceeded 8 percent (5 minutes) of the time during the monitoring period. Figure 1 shows the locations of each of the noise monitoring sites.

Figure 1

Noise Monitoring Locations



LT-# **Continuous Noise Monitoring Sites**

ST-# **Short-term Noise Monitoring Sites**

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The noise level measurement survey results are provided in Table 4. Figures 2A through 2D shows the hourly ambient (L50) noise levels for each location over the noise monitoring period for each of the four continuous noise monitoring locations. See Appendix B for the complete continuous hourly noise measurement results.

Larson Davis Laboratories (LDL) Model 820 and Model 824 precision integrating sound level meters were used for the ambient noise level measurement survey. The meters were calibrated before and after use with an LDL Model CAL200 acoustical calibrator to ensure the accuracy of the measurements. Microphones were fitted with LDL windscreens to minimize the affects of wind across the diaphragm of the microphone. In addition, the continuous noise monitors were fitted with factory weather enclosures to ensure that moisture or condensation did not affect the microphone and preamplifier electronics. The equipment used meets all pertinent specifications of the American National Standards Institute for Type 1 sound level meters and 1/3 octave band filters (ANSI S1.4). All meters were set on A-weighting, slow response, and collected data in the dynamic range of 20 Hz to 20000 Hz.

Table 4
Summary of Ambient Noise Monitoring Results

Site	Date	Ldn, dBA	Daytime Hourly Average Noise Levels, dBA			Nighttime Hourly Average Noise Levels, dBA		
			Leq	L50	L08	Leq	L50	L08
LT-1	4/20/2011 – Wed.	50.7	47.8	42	50	43.3	35	43
	4/21/2011 – Thrs.	50.5	47.8	42	51	43.0	37	44
	4/22/2011 – Fri.	52.4	50.0	43	52	44.7	37	44
	4/23/2011 – Sat.	52.0	49.6	43	52	44.3	40	47
	4/24/2011 – Sun.	5.3.2	48.0	42	52	46.5	40	47
	4/25/2011 – Mon.	51.9	50.2	44	52	43.8	38	45
	4/26/2011 – Tue.	50.1	45.9	41	49	43.1	40	45
LT-2	4/20/2011 – Wed.	52.8	50.1	43	51	45.2	39	46
	4/21/2011 – Thrs.	53.5	48.2	44	52	46.9	38	49
	4/22/2011 – Fri.	54.7	48.3	44	51	48.3	45	51
	4/23/2011 – Sat.	51.6	48.4	43	51	44.3	39	48
	4/24/2011 – Sun.	55.6	50.0	47	54	49.1	44	51
	4/25/2011 – Mon.	57.8	58.4	55	61	46.5	42	49
	4/26/2011 – Tue.	55.5	50.0	46	53	48.9	45	51
LT-3	4/20/2011 – Wed.	51.9	49.7	41	49	44.2	40	45
	4/21/2011 – Thrs.	51.4	48.1	42	49	44.1	40	45
	4/22/2011 – Fri.	54.0	51.7	43	50	46.3	41	46
	4/23/2011 – Sat.	53.8	49.1	42	50	47.0	44	48
	4/24/2011 – Sun.	52.2	47.6	45	50	45.5	43	48
	4/25/2011 – Mon.	52.6	50.1	45	51	44.9	40	46
	4/26/2011 – Tue.	53.7	48.1	45	50	47.1	43	48
LT-4	4/28/2011 – Thrs.	50.9	45.5	43	48	44.3	42	47
	4/29/2011 – Fri.	47.2	45.6	42	49	39.0	33	40
	4/30/2011 – Sat.	45.8	44.6	41	46	37.3	32	38
	5/01/2011 – Sun.	46.4	41.3	38	45	38.5	33	40
	5/02/2011 – Mon.	48.3	39.8	39	43	40.2	34	41
	5/03/2011 – Tue.	47.9	47.1	42	50	39.0	36	41
ST-1	4/20/2011 – Thrs	---	---	---	---	60.8	---	---
ST-2	4/20/2011 – Thrs	---	---	---	---	51.6	---	---
ST-3	4/20/2011 – Thrs	---	---	---	---	37.3	---	---
ST-4	4/20/2011 – Thrs	---	---	---	---	45.2	---	---

Source: j.c. brennan & associates, Inc. 2011.

Figure 2A: Hourly Ambient Noise Levels - Site LT-1

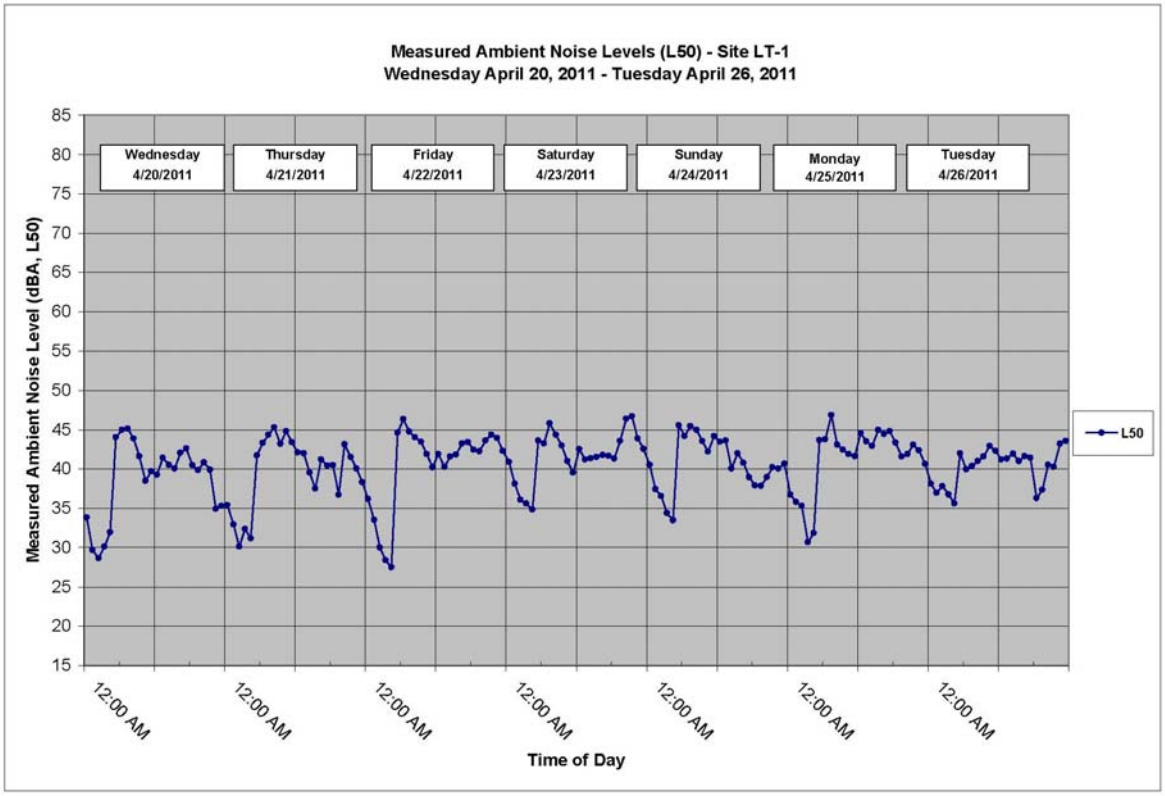


Figure 2B: Hourly Ambient Noise Levels - Site LT-2

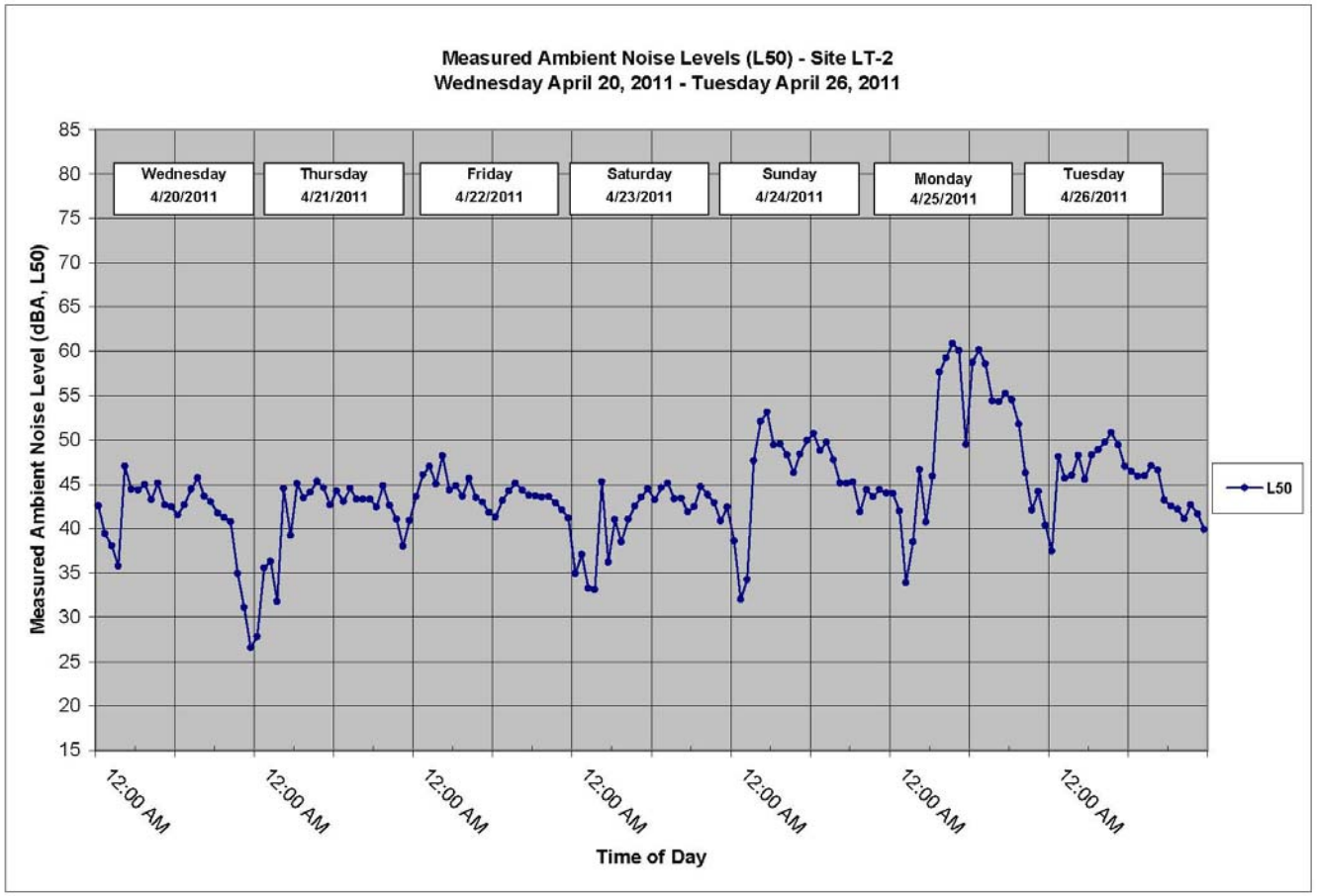


Figure 2C: Hourly Ambient Noise Levels - Site LT-3

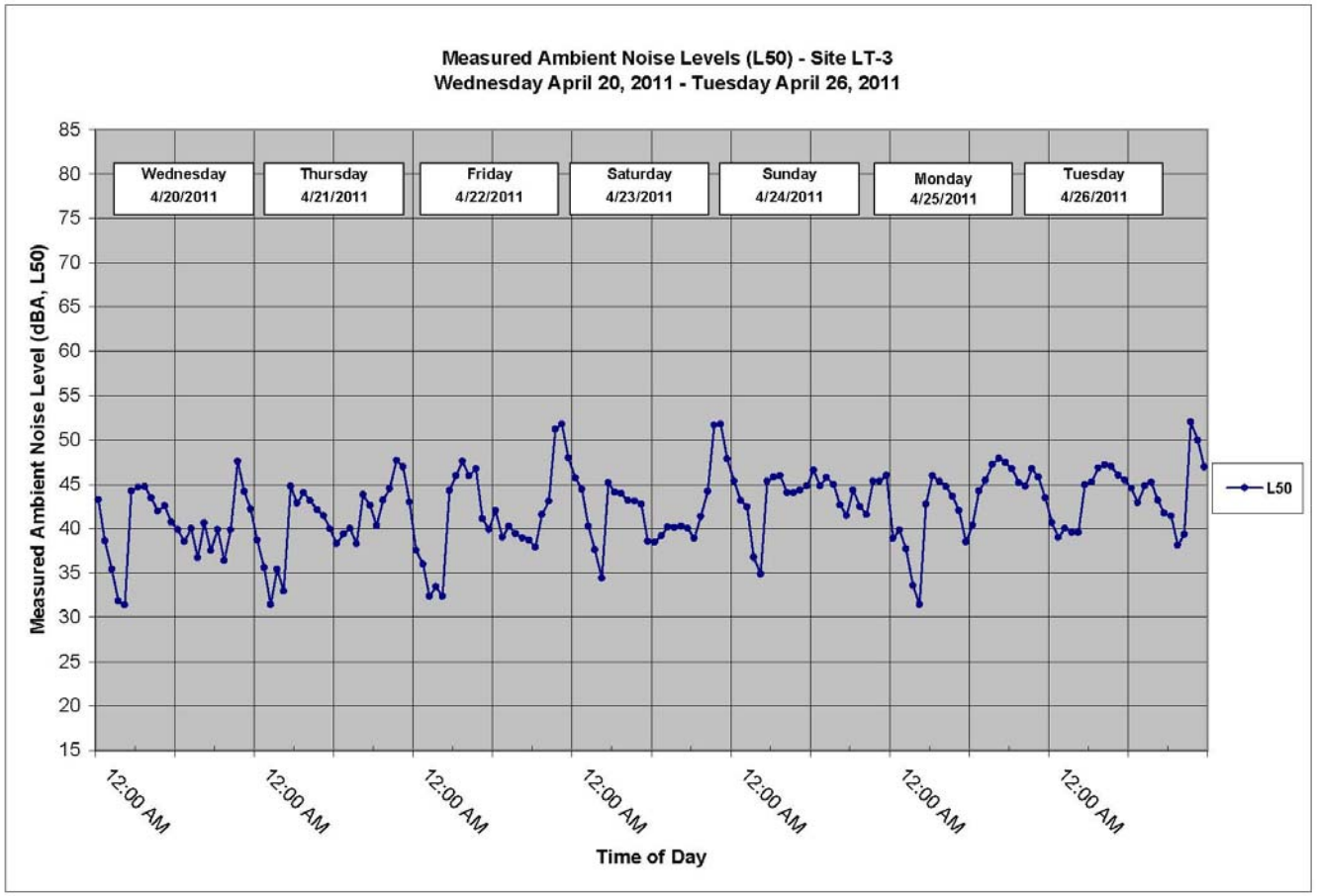
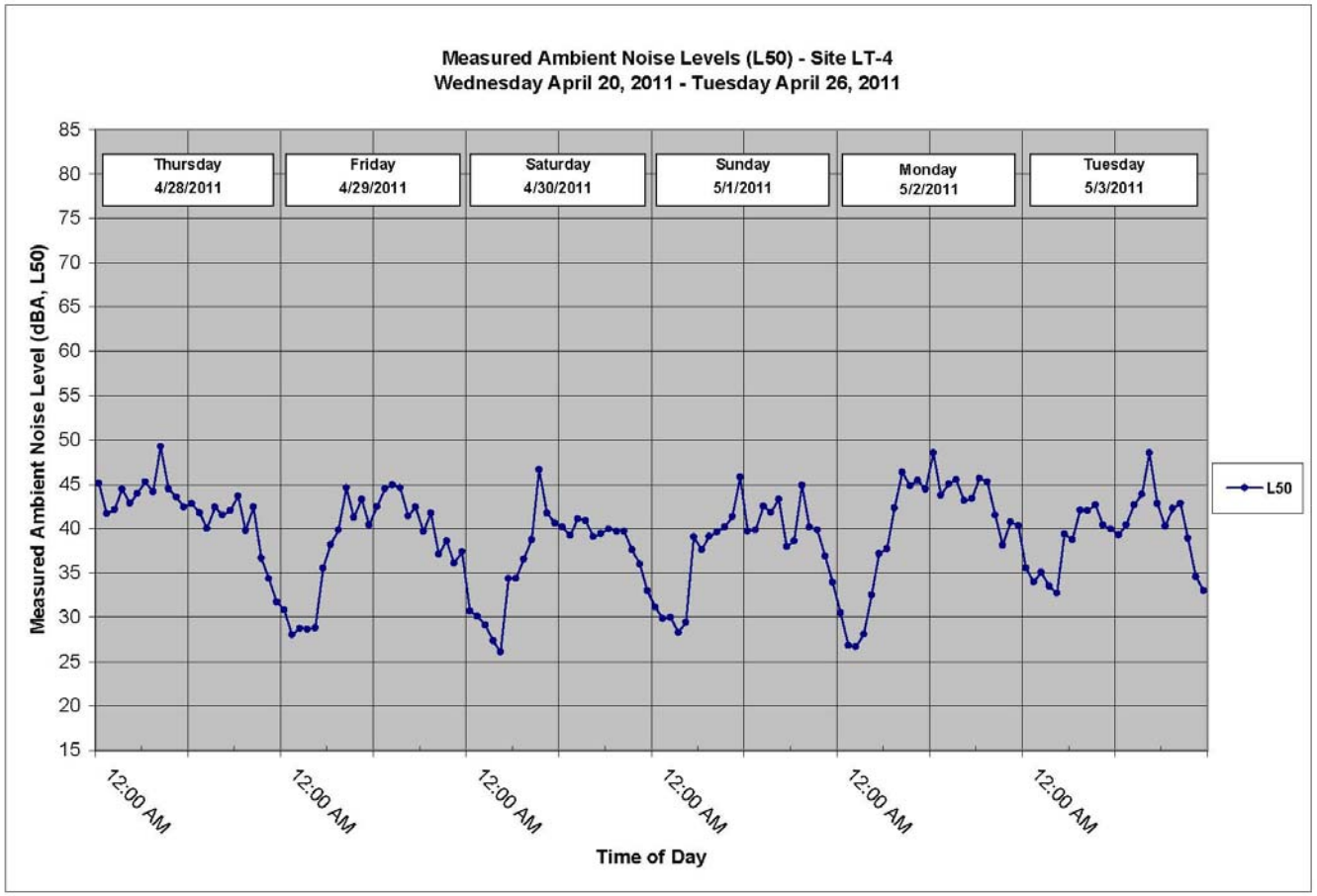


Figure 2D: Hourly Ambient Noise Levels - Site LT-4



Description of Ambient Noise Monitoring Locations

Below is a description of each of the ambient noise measurement sites:

Site LT-1: This was a long term continuous hourly noise measurement site which was monitored for seven consecutive days from April 20th through April 26th, 2011. The site was located approximately 200 feet east of Lummi Shore Drive, in the wetland restoration area of Smugglers Slough. The coordinates are 48°48'4.63"N, 122º37'10"W.

Site LT-2: This was a long term continuous hourly noise measurement site which was monitored for seven consecutive days from April 20th through April 26th, 2011. The site was located at the Smokehouse Road Meteorological Tower site. The coordinates are 48°44'50"N, 122°37'34"W.

Site LT-3: This was a long term continuous hourly noise measurement site which was monitored for seven consecutive days from April 20th through April 26th, 2011. The site was located Jefferson residence located west of Haxton Road. The coordinates are 48º48'7"N, 122º38'2"W.

Site LT-4: This was a long term continuous hourly noise measurement site which was monitored for seven consecutive days from April 28th through May 3rd, 2011. The site was located at the Gooseberry Point Fire Station. The coordinates are 48°44'11"N, 122°40'5"W.

Site ST-1: This was a short term noise measurement site which was monitored once during the nighttime period on April 20, 2011. The site was located in the parking lot of the Silver Reef Casino. This site was also used for collecting background infrasound noise levels which are discussed later in this report.

Site ST-2: This was a short term noise measurement site which was monitored once during the nighttime period on April 20, 2011. The site was located on Lake Terrell Road, south of Slater Road. This site was also used for collecting background infrasound noise levels which are discussed later in this report.

Site ST-3: This was a short term noise measurement site which was monitored once during the nighttime period on April 20, 2011. The site was located at the intersection of Chief Martin Road and Scott Road. This site was also used for collecting background infrasound noise levels which are discussed later in this report.

Site ST-4: This was a short term noise measurement site which was monitored once during the nighttime period on April 20, 2011. This site was located on Harden Road, west of Haxton Way. This site was also used for collecting background infrasound noise levels which are discussed later in this report.

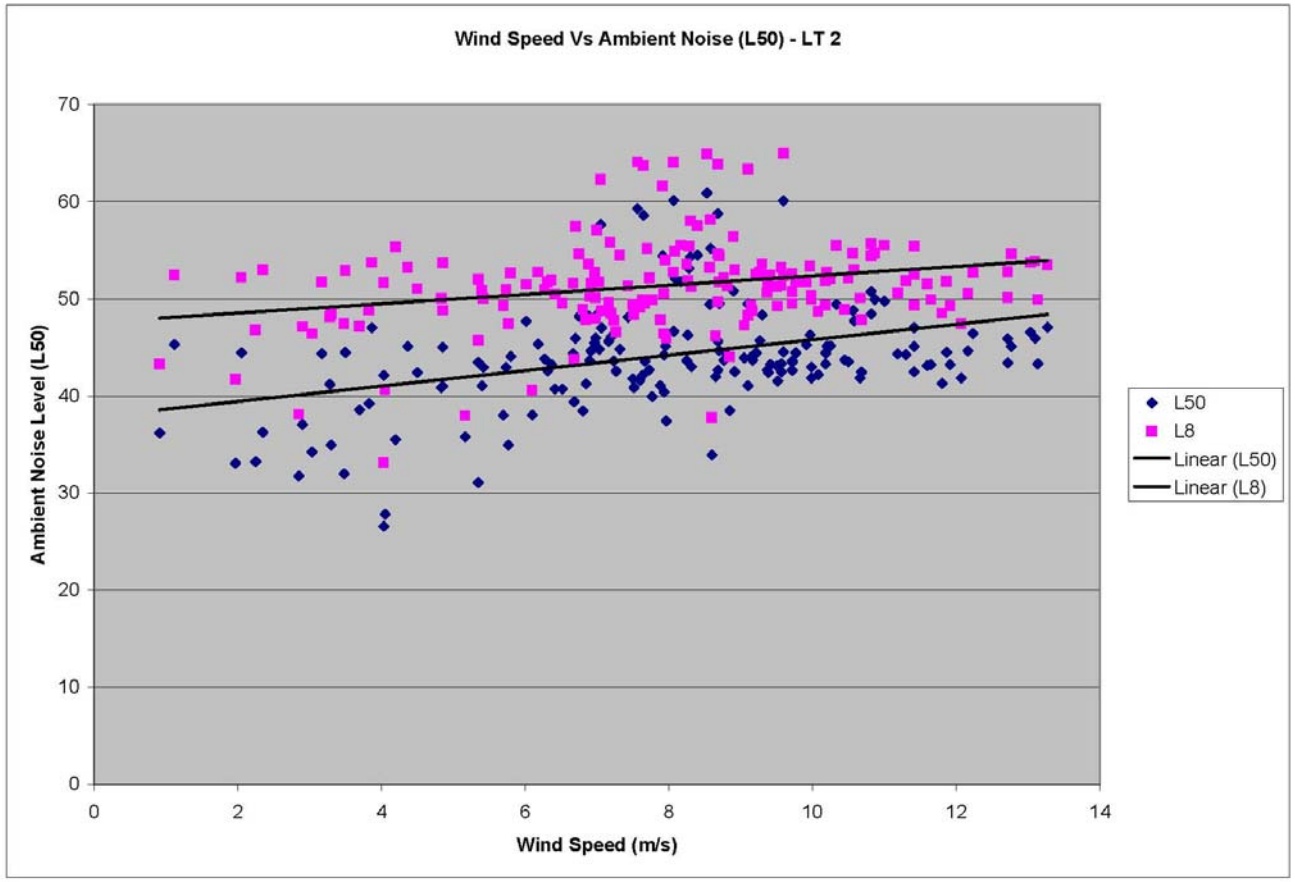
Table 4 shows the typical background noise levels during the daytime periods (7:00 a.m. – 10:00 p.m.) and nighttime periods (10:00 p.m. – 7:00 a.m.) at each of the continuous (LT) noise monitoring sites. In addition, Appendix B shows the complete results of the noise monitoring data for each day of monitoring. The maximum noise levels represent the maximum recorded noise levels for each hour. The hourly Leq values represent the energy average noise levels, which account for all measured sound, including periodic loud events. The L50 sound levels represent the mean sound level measured for the hour. The L50 discounts short-term periodic loud events. The L08 hourly noise levels discount all background noise, with the exception of the periodic loud events. Measured noise levels at the short-term noise measurement sites only included the average Leq noise levels.

Ambient Noise and Wind Speed

Another means of assessing the ambient noise environment is to prepare a scatter plot of measured ambient noise levels versus wind speeds. By adding a regression trendline to the collected data at Site LT-2 (the Smokehouse Meteorological Tower), it is possible to estimate the background noise levels as a function of wind speed. Wind data used for the regression analysis was collected at the Smokehouse meteorological tower. The results of the analysis are provided in Figure 3.

Figure 3 shows the wind speed data as compared to the noise measurement data collected at the meteorological tower (Site LT-2).

Figure 3: Ambient vs. Wind – Site LT-2



Measured Infrasound Noise Levels

j.c. brennan & associates, Inc. also conducted infrasound noise measurements at each of the short-term noise monitoring sites described above. The intent of conducting the infrasound noise measurements was to determine the background infrasound which is currently present in the environment.

Noise measurement equipment included an LDL Model 824 precision integrating sound level meter which was equipped with a G.R.A.S Type 40AN and Type 26AK pre-polarized low frequency microphone and preamplifier, respectively. The equipment meets all ANSI specifications for low frequency 1/3 octave band and narrow band noise measurements.

The results of the infrasound noise measurements are shown in Table 5. Based upon the measured background infrasound measurements, it is apparent that infrasound is already present in the background noise environment. Since winds were calm during the infrasound noise measurements, the existing measured infrasound levels are assumed to be due to distant roadway traffic. Based upon our experience conducting infrasound measurements during periods of wind between 10 and 15 mph, measured infrasound levels are in the 70 dB to 80 dB range.

Table 5
Measured Background Infrasound Noise Levels

Location	Date	Measured Levels Octave Band			
		1 Hz	2 Hz	5 Hz	10 Hz
ST-1 Silver Reef Casino	April 20, 2011	69.7 dB	64.3 dB	53.8 dB	52.9 dB
ST-2 Lake Terrell Road, south of Slater Road	April 20, 2011	73.8 dB	68.2 dB	53.9 dB	52.4 dB
ST-3 Intersection of Chief Martin Road and Scott Road	April 20, 2011	64.1 dB	58.7 dB	50.9 dB	49.7 dB
ST-4 Harden Road, west of Haxton Way	April 20, 2011	63.3 dB	57.6 dB	53.2 dB	46.9 dB
Source: j.c. brennan & associates, Inc. 2011.					

CALIBRATION OF CadnaA NOISE PREDICTION MODEL

Future analysis of wind turbine noise impacts will be provided in the future, when potential wind turbine types, configurations and turbine arrays have been determined. In order to predict noise levels at the nearest noise-sensitive receptors, j.c. brennan & associates, Inc. will utilize the CadnaA Noise Prediction Model, which is produced by DataKustik. The CadnaA model is able to predict overall noise levels for multiple noise sources, while also accounting for topography, air temperature, humidity, wind speed and wind direction. Inputs to the CadnaA model include ground topography and type, source locations, source heights, receiver locations, noise source sound power levels, and meteorological data.

As a means of calibrating the CadnaA Noise Prediction Model for future use, the model was used to predict noise levels associated with the existing Tsunami Warning System which is currently installed on the Lummi Reservation. Currently there are 3 warning towers located on the Lummi Reservation. The systems are manufactured by Federal Signal and include omni-directional speaker arrays, which produce a noise level of 125 dBC, at a distance of 100 feet. The systems are typically exercised on Friday's during the 12:00 p.m. hour. The alert notification is the "Westminster Chimes" signal.

As a means of collecting octave band noise levels associated with the Westminster Chimes signal, j.c. brennan & associates, Inc. conducted 1/3 octave band sound level measurements of the signal as produced on the Federal Signal website. This data was converted to sound power levels and used as direct inputs to the CadnaA Model. In addition, topographic base maps, and tower heights and locations which were provided by the Lummi Natural Resources Department were also used as direct inputs to the model. The CadnaA Noise Prediction Model was used to predict noise levels from the Tsumani Warning System at noise monitoring sites LT-1, LT-2 & LT-3 for the 12:00 p.m. hour on Friday April 22, 2011 when the warning signal was exercised.

> *Note: The warning system was supposed to be exercised on Friday April 29, 2011 when noise measurements were being conducted at monitoring site LT-4. However, based upon the measured noise levels collected at that site, it was apparent that the warning system was not exercised on that day.*

Table 6 shows the A-weighted sound power octave band levels which were input to the CadnaA Noise Prediction Model. Wind direction and wind speed were not entered into the model.

Table 6
Tsunami Warning System Octave Band Sound Power Levels, dBA

63.5 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
118	134	158	154	146	141	140	130

Source: General Electric & Siemens Power

Predicted Tsunami Warning System Noise Levels

Figure 4 shows the predicted Tsunami Warning System maximum noise levels at each of the continuous noise measurement sites. Table 7 shows the predicted noise levels as compared to the measured noise levels at each of the sites.

As stated earlier, the warning system was supposed to be exercised on Friday April 29, 2011 when noise measurements were being conducted at monitoring site LT-4. However, based upon the measured noise levels collected at that site, it was apparent that the warning system was not exercised on that day. There fore, Table 7 does not provide a correlation between the measured noise levels and the warning system noise levels.

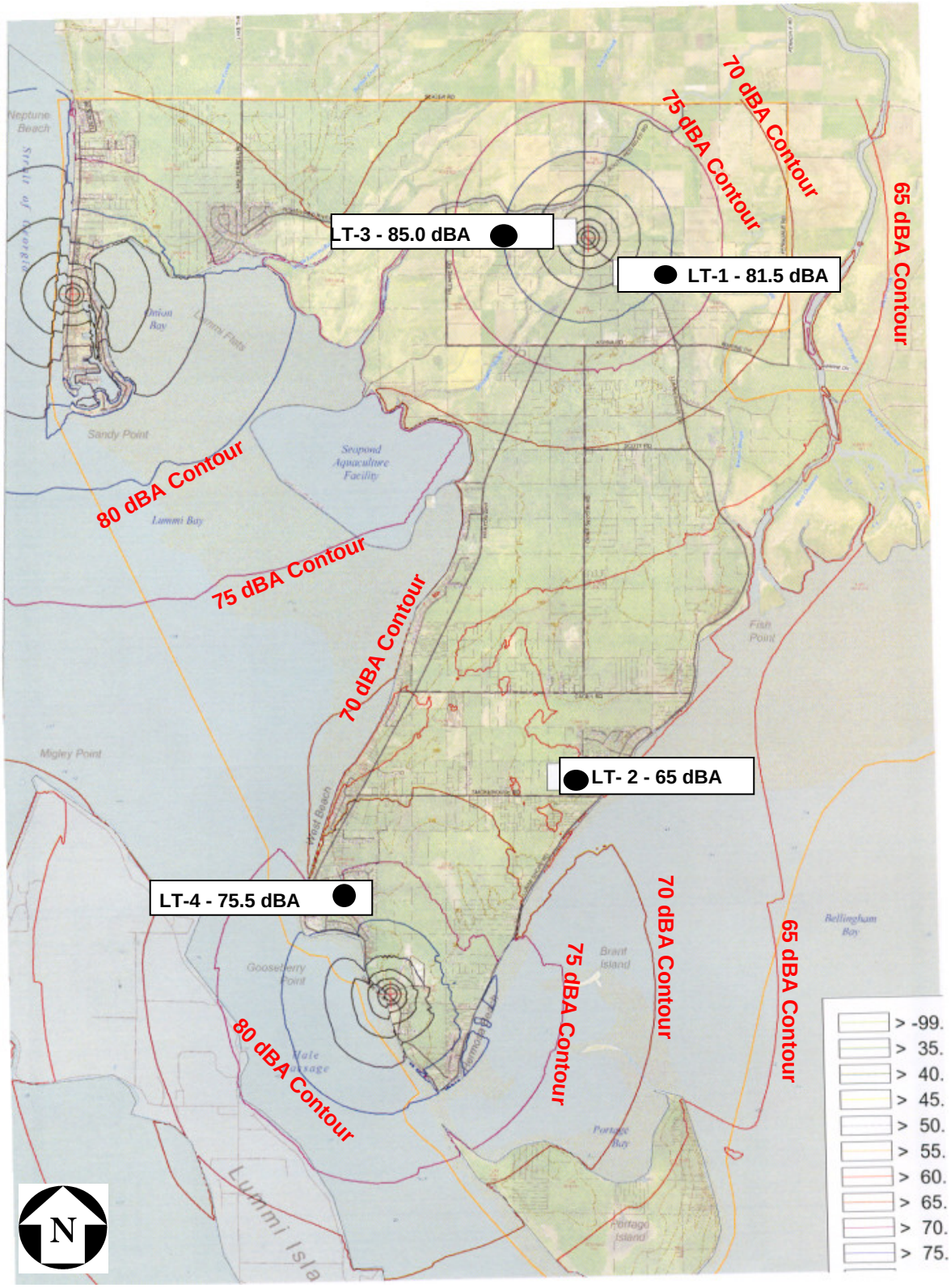
Table 7
Predicted vs Measured Tsunami Warning System Noise Levels

Location	Description	Measured (Lmax)	Predicted (Lmax)	Difference
LT-1	Lummi Shore Drive/Smugglers Slough	80.8 dBA	81.5 dBA	+0.7 dBA
LT-2	Smokehouse Road Meteorological Tower	64.5 dBA	65.0 dBA	+0.5 dBA
LT-3	Jefferson Residence West of Haxton Road	86.5 dBA	85.0 dBA	- 1.5 dBA
LT-4	Gooseberry Point Fire Station	NA	75.5 dBA	NA
Measured noise levels are during the 12:00 p.m. hour on Friday April 22, 2011 Predicted noise levels are based upon the CadnaA Noise Prediction Model and noise data provided by Federal Signal				

Based upon the analysis, the CadnaA Noise Prediction Model predicted noise levels within 1.5 dBA of those which were measured at each of the continuous (LT) noise measurement sites.

Figure 4

Tsunami Warning System Predicted Noise Levels



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Appendix A

Acoustical Terminology

Acoustics	The science of sound.
Ambient Noise	The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study.
Attenuation	The reduction of an acoustic signal.
A-Weighting	A frequency-response adjustment of a sound level meter that conditions the output signal to approximate human response.
Decibel or dB	Fundamental unit of sound, A Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A Decibel is one-tenth of a Bell.
CNEL	Community Noise Equivalent Level. Defined as the 24-hour average noise level with noise occurring during evening hours (7 - 10 p.m.) weighted by a factor of three and nighttime hours weighted by a factor of 10 prior to averaging.
Frequency	The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or hertz.
Ldn	Day/Night Average Sound Level. Similar to CNEL but with no evening weighting.
Leq	Equivalent or energy-averaged sound level.
Lmax	The highest root-mean-square (RMS) sound level measured over a given period of time.
L(n)	The sound level exceeded a described percentile over a measurement period. For instance, an hourly L50 is the sound level exceeded 50% of the time during the one hour period.
Loudness	A subjective term for the sensation of the magnitude of sound.
Noise	Unwanted sound.
Peak Noise	The level corresponding to the highest (not RMS) sound pressure measured over a given period of time. This term is often confused with the "Maximum" level, which is the highest RMS level.
RT_{60}	The time it takes reverberant sound to decay by 60 dB once the source has been removed.
Sabin	The unit of sound absorption. One square foot of material absorbing 100% of incident sound has an absorption of 1 sabin.
Threshold of Hearing	The lowest sound that can be perceived by the human auditory system, generally considered to be 0 dB for persons with perfect hearing.
Threshold of Pain	Approximately 120 dB above the threshold of hearing.
Impulsive	Sound of short duration, usually less than one second, with an abrupt onset and rapid decay.
Simple Tone	Any sound which can be judged as audible as a single pitch or set of single pitches.

Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-1
Wednesday, April 20, 2011

Hour	Leq	Lmax	L50	L8
0:00	38.2	55.34	33.86	39.94
1:00	36.76	55.44	29.68	38.05
2:00	35.59	53.19	28.65	37.48
3:00	35.09	55.8	30.13	36.02
4:00	34.06	50.42	31.94	36.84
5:00	49.23	66.52	44.02	52.06
6:00	47.9	63.37	44.96	51.72
7:00	47.48	61.37	45.12	50.81
8:00	49.23	68.78	43.87	51.93
9:00	48.52	67.68	41.64	50.98
10:00	43.64	64.11	38.48	47.12
11:00	46.04	70.59	39.69	49.85
12:00	50.11	72.81	39.27	50.41
13:00	46.34	63.37	41.44	51.13
14:00	43.87	56.9	40.52	48.17
15:00	51.31	75.3	40.06	50.48
16:00	45.87	61.04	42.05	50.3
17:00	50.5	72.52	42.61	51.27
18:00	46.12	61.74	40.5	50.94
19:00	43.73	55.46	39.87	48.5
20:00	44.36	59.77	40.86	48.86
21:00	49.32	71.73	39.91	49.59
22:00	41.34	61.69	34.93	44.68
23:00	40.42	63.55	35.31	43.82

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	51.3	43.6	47.8	49.2	34.1	43.3
Lmax (Maximum)	75.3	55.5	65.5	66.5	50.4	58.4
L50 (Median)	45.1	38.5	41.1	45.0	28.7	34.8
L8	51.9	47.1	50.0	52.1	36.0	42.3

Computed Ldn, dB	50.7
% Daytime Energy	83%
% Nighttime Energy	17%

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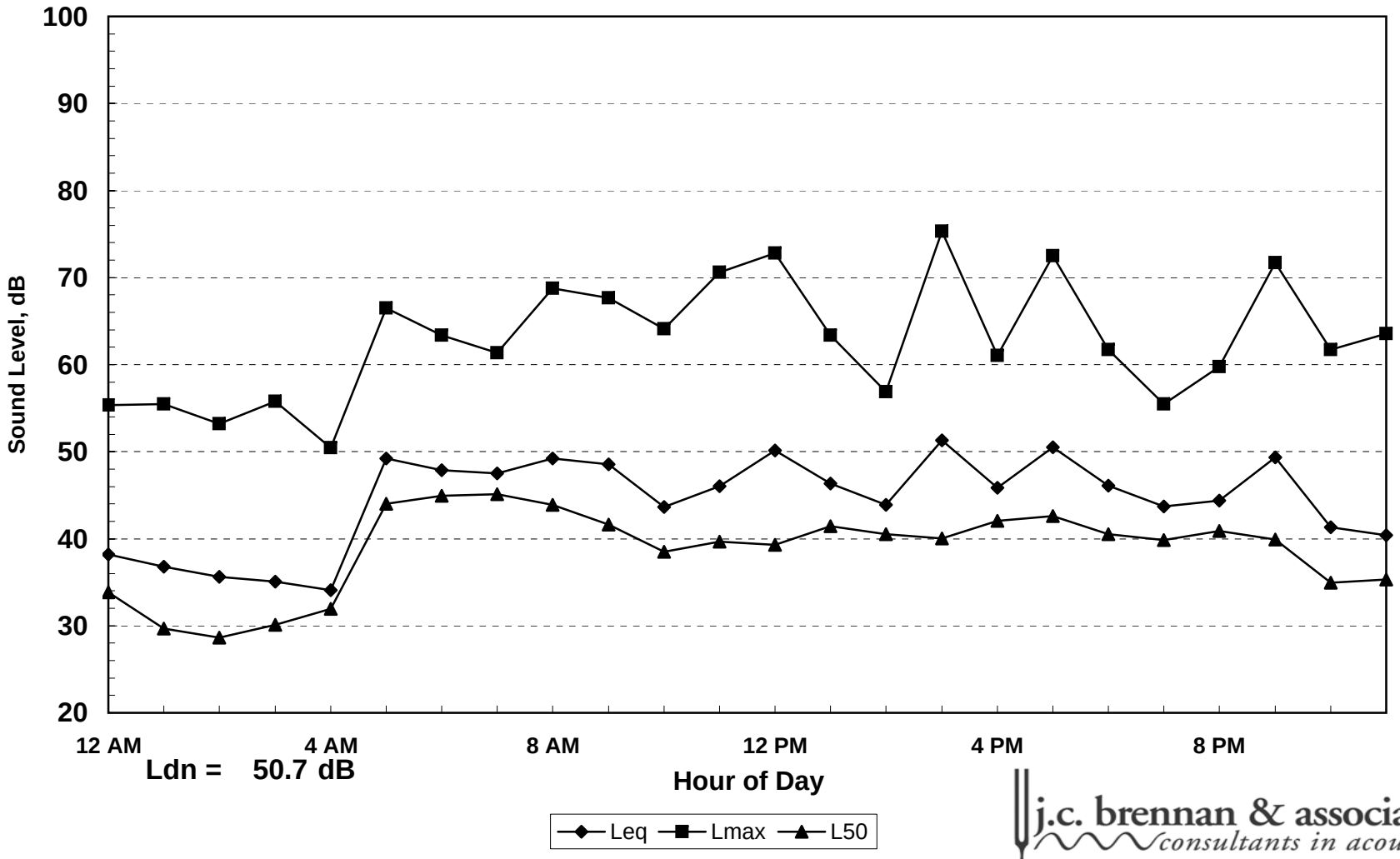
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-1

Wednesday, April 20, 2011



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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-1
Thursday, April 21, 2011

Hour	Leq	Lmax	L50	L8
0:00	39.97	58.52	35.42	42.81
1:00	37.24	51.76	32.94	41.37
2:00	32.57	48.11	30.1	34.32
3:00	35.24	48.61	32.38	38.83
4:00	34.06	50.85	31.18	36.27
5:00	46.62	61.23	41.76	51.62
6:00	48.43	69.1	43.29	52.86
7:00	47.61	69.98	44.34	51.04
8:00	51.56	80.98	45.29	52.97
9:00	47.24	66.87	43.18	51.72
10:00	50.5	73.14	44.8	51.84
11:00	47.85	67.91	43.41	51.39
12:00	48.52	69.96	42.09	50.4
13:00	47.17	66.84	42.02	50.68
14:00	50.38	77.58	39.55	49.56
15:00	43.1	57.61	37.52	48.45
16:00	46.23	66.17	41.21	50.02
17:00	46.29	63.8	40.42	50.66
18:00	46.36	65.6	40.5	50.16
19:00	43.57	61.46	36.69	48.73
20:00	46.34	62.91	43.14	50.73
21:00	45.04	60.05	41.52	49.66
22:00	43.83	56.51	40.05	48.84
23:00	42.62	55.01	38.31	47.97

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	51.6	43.1	47.8	48.4	32.6	43.0
Lmax (Maximum)	81.0	57.6	67.4	69.1	48.1	55.5
L50 (Median)	45.3	36.7	41.7	43.3	30.1	36.2
L8	53.0	48.5	50.5	52.9	34.3	43.9

Computed Ldn, dB	50.5
% Daytime Energy	83%
% Nighttime Energy	17%

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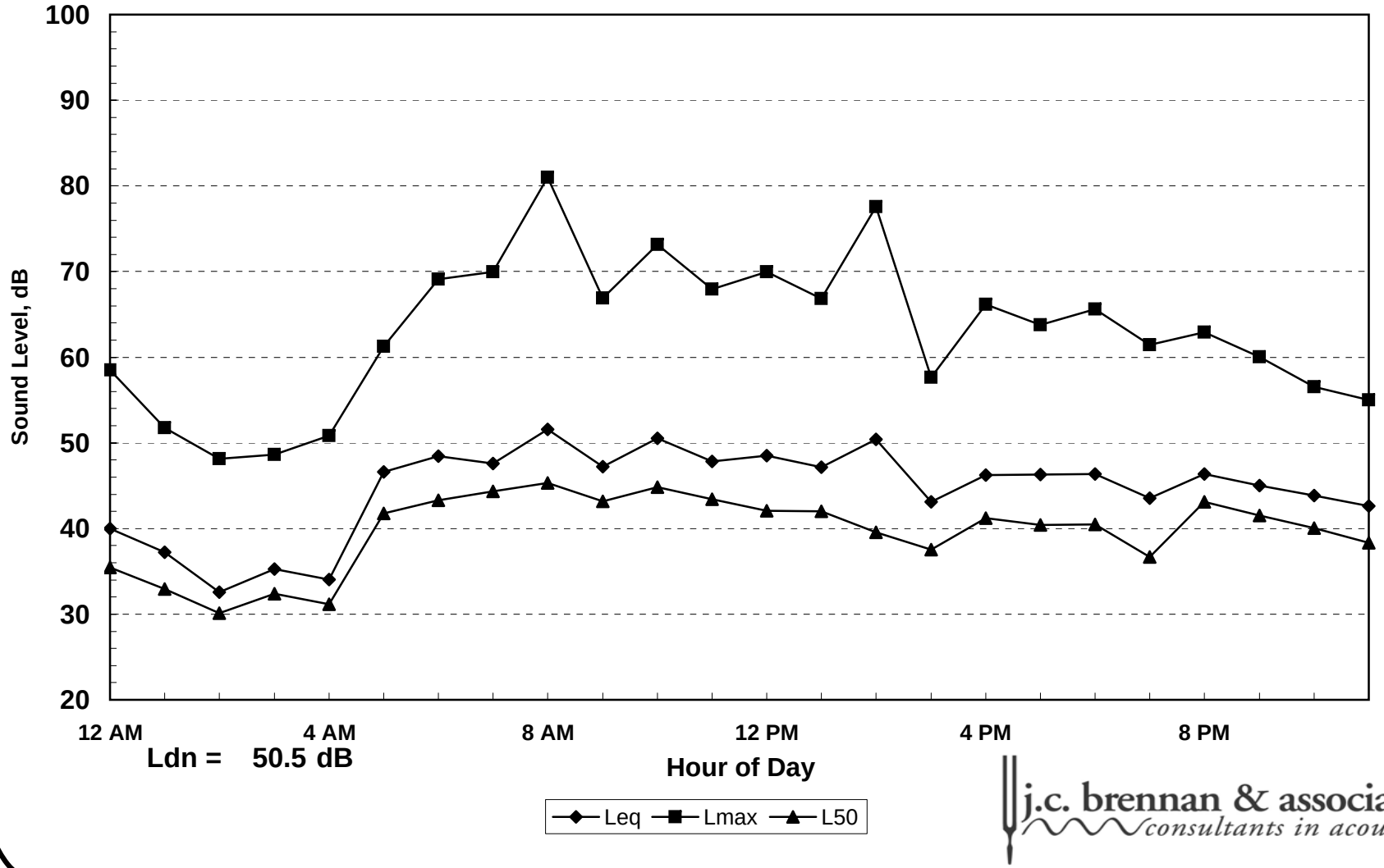
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-1

Thursday, April 21, 2011



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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-1
Friday, April 22, 2011

Hour	Leq	Lmax	L50	L8
0:00	39.4	54.51	36.17	42.49
1:00	36.09	51.13	33.5	38.8
2:00	35.94	51.87	30.03	39.61
3:00	33.27	50.49	28.37	35.31
4:00	30.82	50.99	27.52	31.52
5:00	47.27	60.48	44.63	51.93
6:00	50.64	68.82	46.32	54.64
7:00	48.64	66.94	44.77	51.42
8:00	49.45	70.35	44.05	53.09
9:00	47.4	63.55	43.44	51.57
10:00	46.24	64.95	41.91	50.95
11:00	46.08	63.39	40.24	50.52
12:00	53.39	80.77	41.91	50.91
13:00	44.66	63.16	40.28	48.48
14:00	55.13	81.07	41.6	51.24
15:00	53.98	80.35	41.84	50.49
16:00	50.63	71.8	43.26	51.78
17:00	48.42	66.9	43.43	51.87
18:00	46.64	60.94	42.48	50.98
19:00	45.87	61.03	42.27	50.26
20:00	47.3	62.71	43.6	51.87
21:00	46.94	56.79	44.37	51.19
22:00	46.94	59.55	43.92	51.25
23:00	44.52	56.28	42.32	48.32

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	55.1	44.7	50.0	50.6	30.8	44.7
Lmax (Maximum)	81.1	56.8	67.6	68.8	50.5	56.0
L50 (Median)	44.8	40.2	42.6	46.3	27.5	37.0
L8	53.1	48.5	51.1	54.6	31.5	43.8

Computed Ldn, dB	52.4
% Daytime Energy	85%
% Nighttime Energy	15%

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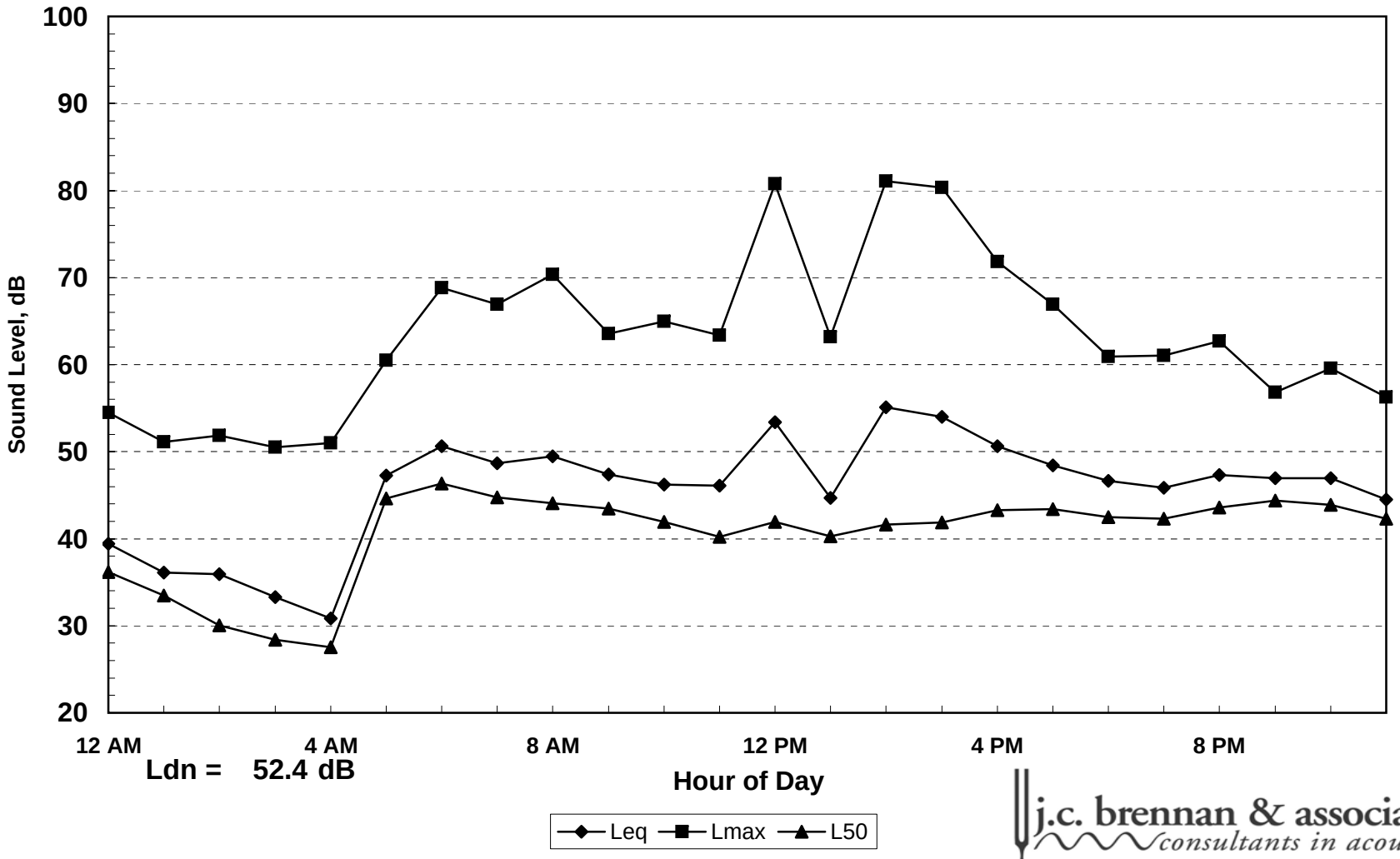
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-1

Friday, April 22, 2011



Ldn = 52.4 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-1
Saturday, April 23, 2011

Hour	Leq	Lmax	L50	L8
0:00	43.66	65.83	40.91	46.43
1:00	42.45	56.33	38.11	47.18
2:00	41.54	60.43	36.09	44.6
3:00	41.59	58.65	35.59	46.45
4:00	38.57	59.9	34.85	38.59
5:00	46.05	56.88	43.63	50.34
6:00	47.75	63.87	43.23	51.2
7:00	51.63	72.5	45.79	55.72
8:00	50.25	66.69	44.34	54.22
9:00	51.05	67.32	42.99	55.46
10:00	48.16	70.41	40.99	51.33
11:00	53.73	78.3	39.56	51.37
12:00	51.19	72.1	42.5	52.2
13:00	47.31	68.23	41.23	49.77
14:00	45.57	59.66	41.37	50.51
15:00	51.23	73.95	41.53	50.23
16:00	48.42	69.02	41.77	50.89
17:00	47.68	69.37	41.69	50.07
18:00	44.62	58.58	41.34	49.02
19:00	47.17	63.19	43.58	51.05
20:00	48.73	66.38	46.39	52.53
21:00	47.71	56.84	46.7	50.72
22:00	45.55	60.57	43.88	48.8
23:00	44.73	56.92	42.58	48.05

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	53.7	44.6	49.6	47.8	38.6	44.3
Lmax (Maximum)	78.3	56.8	67.5	65.8	56.3	59.9
L50 (Median)	46.7	39.6	42.8	43.9	34.9	39.9
L8	55.7	49.0	51.7	51.2	38.6	46.8

Computed Ldn, dB	52.0
% Daytime Energy	85%
% Nighttime Energy	15%

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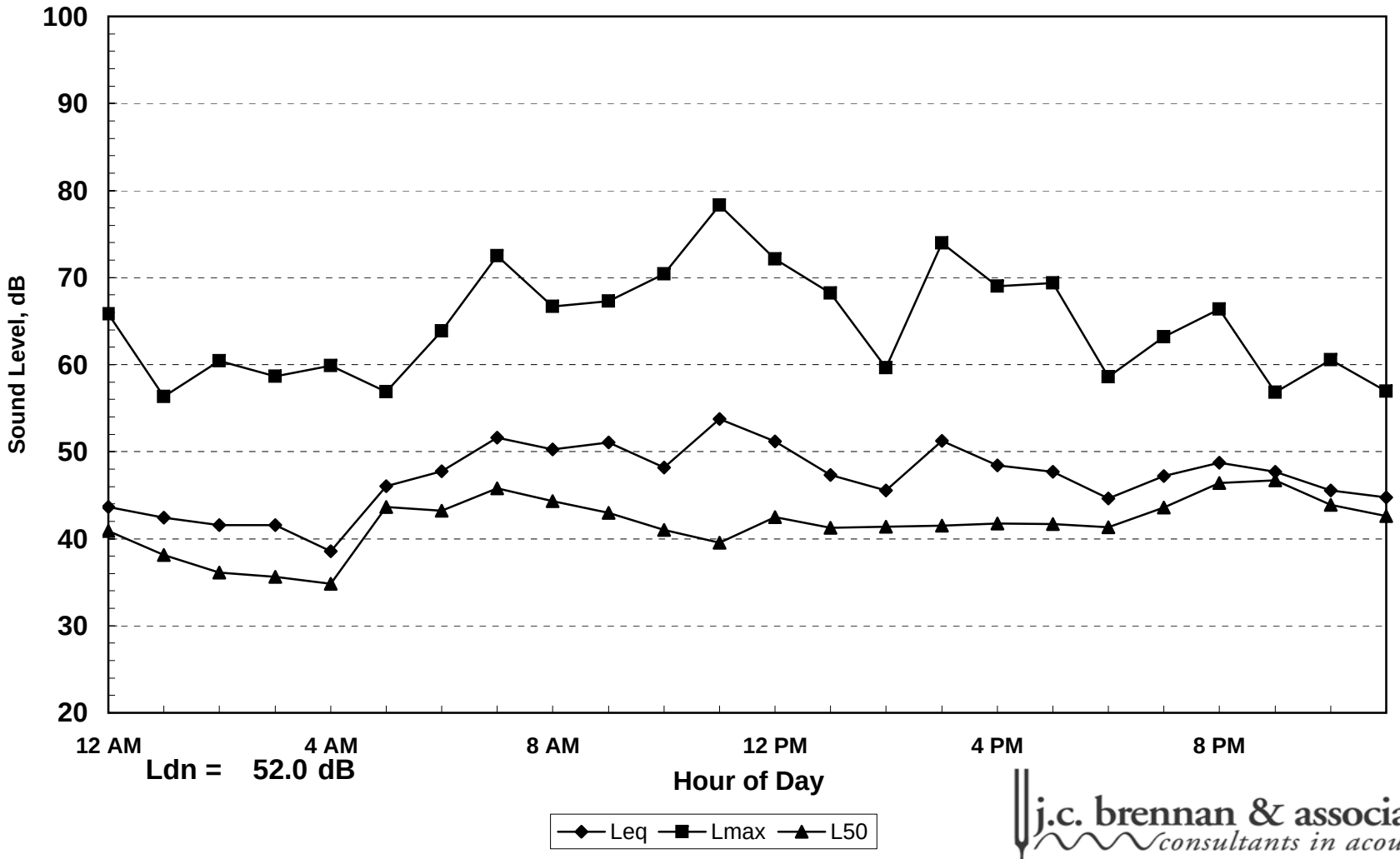
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-1

Saturday, April 23, 2011



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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-1
Sunday, April 24, 2011

Hour	Leq	Lmax	L50	L8
0:00	43.04	56.9	40.55	46.62
1:00	40.48	60.11	37.44	41.21
2:00	39.66	56.96	36.56	41.97
3:00	37.31	54.19	34.43	38.83
4:00	37.06	53.8	33.46	40.12
5:00	52.31	65.8	45.54	57.21
6:00	51.27	66.74	44.21	56.08
7:00	52.01	70.02	45.45	57.19
8:00	51.02	65.83	44.98	55.48
9:00	49.52	67.26	43.56	53.24
10:00	48.66	67.54	42.21	52.92
11:00	49.61	69.71	44.17	53.29
12:00	48.04	63.15	43.45	52.39
13:00	46.36	60.42	43.63	50.73
14:00	44.73	62.44	40.07	49.68
15:00	48.66	66.81	42	52.68
16:00	45.92	64.3	40.79	50.8
17:00	46.12	65.02	38.95	50.52
18:00	44.76	64.73	37.93	49.24
19:00	44.04	59.03	37.88	49.16
20:00	44.98	59.94	38.96	49.9
21:00	45.1	65.68	40.2	47.09
22:00	44.42	65.03	40.08	47.35
23:00	42.69	58.52	40.69	46.08

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	52.0	44.0	48.0	52.3	37.1	46.5
Lmax (Maximum)	70.0	59.0	64.8	66.7	53.8	59.8
L50 (Median)	45.5	37.9	41.6	45.5	33.5	39.2
L8	57.2	47.1	51.6	57.2	38.8	46.2

Computed Ldn, dB	53.2
% Daytime Energy	70%
% Nighttime Energy	30%

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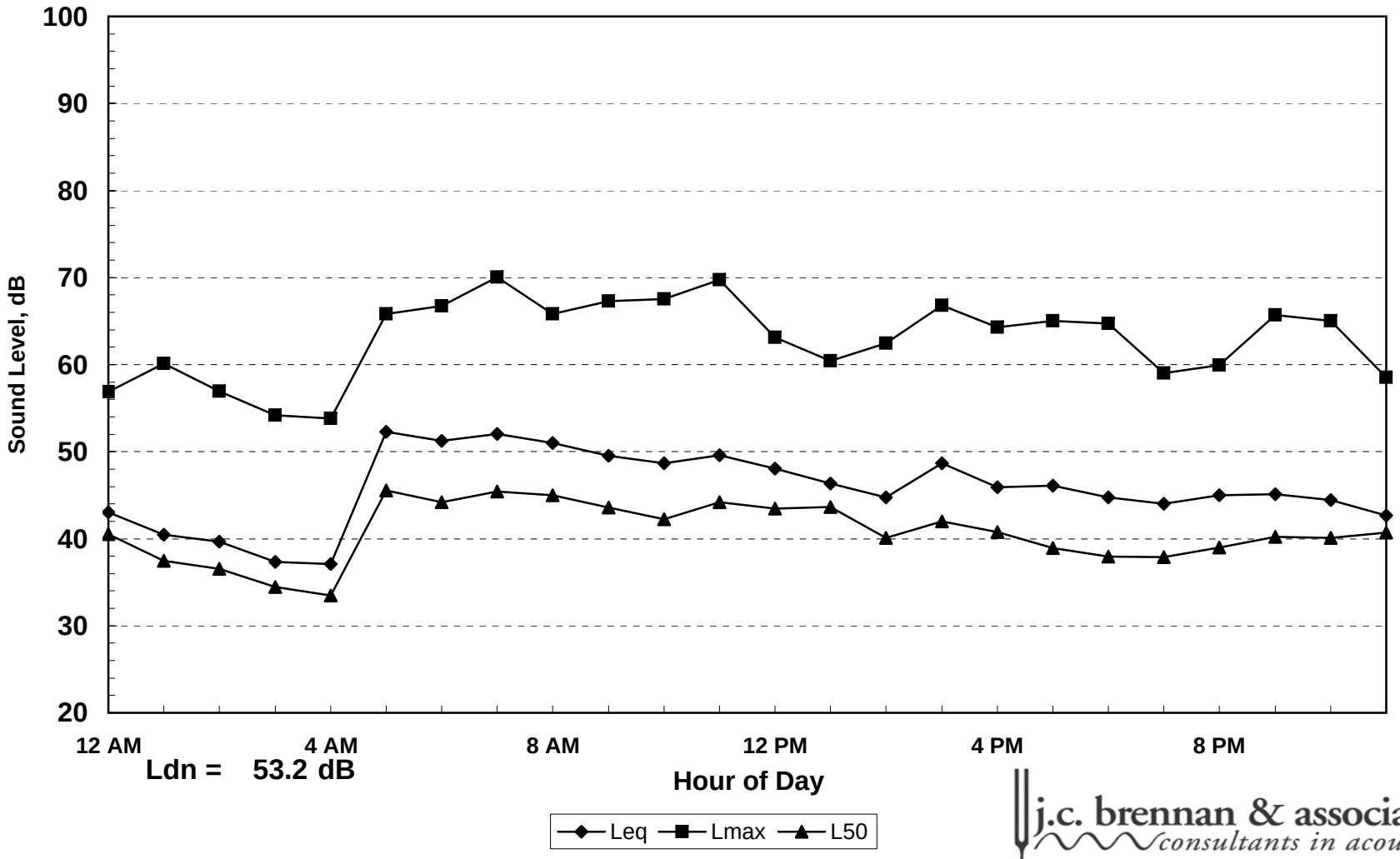
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-1

Sunday, April 24, 2011



Ldn = 53.2 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-1
Monday, April 25, 2011

Hour	Leq	Lmax	L50	L8
0:00	39.68	62.62	36.75	42.55
1:00	39.32	54.61	35.83	43.07
2:00	38.59	51.35	35.28	42.8
3:00	35.57	56.97	30.69	37.41
4:00	35.34	55.22	31.87	37.3
5:00	47.92	61.33	43.68	52.5
6:00	48.49	65.08	43.79	51.95
7:00	53.54	76.94	46.86	55.37
8:00	49.52	70.05	43.11	51.23
9:00	53.98	77.94	42.46	50.4
10:00	53.55	78.95	41.91	50.73
11:00	44.73	57.48	41.61	48.96
12:00	47.03	57.04	44.56	51.48
13:00	46.98	57.91	43.51	51.81
14:00	46.49	62.92	42.96	50.55
15:00	47.66	63.91	44.99	51.25
16:00	47.27	60.77	44.44	51.59
17:00	47.34	60.52	44.84	51.37
18:00	47.15	70.64	43.37	50.73
19:00	44.63	57.01	41.59	49.23
20:00	48.2	72.5	41.87	49.91
21:00	54.59	75.35	43.08	52.64
22:00	45.04	56.19	42.36	49.32
23:00	42.59	56.17	40.63	45.75

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	54.6	44.6	50.2	48.5	35.3	43.8
Lmax (Maximum)	79.0	57.0	66.7	65.1	51.4	57.7
L50 (Median)	46.9	41.6	43.4	43.8	30.7	37.9
L8	55.4	49.0	51.2	52.5	37.3	44.7

Computed Ldn, dB	51.9
% Daytime Energy	88%
% Nighttime Energy	12%

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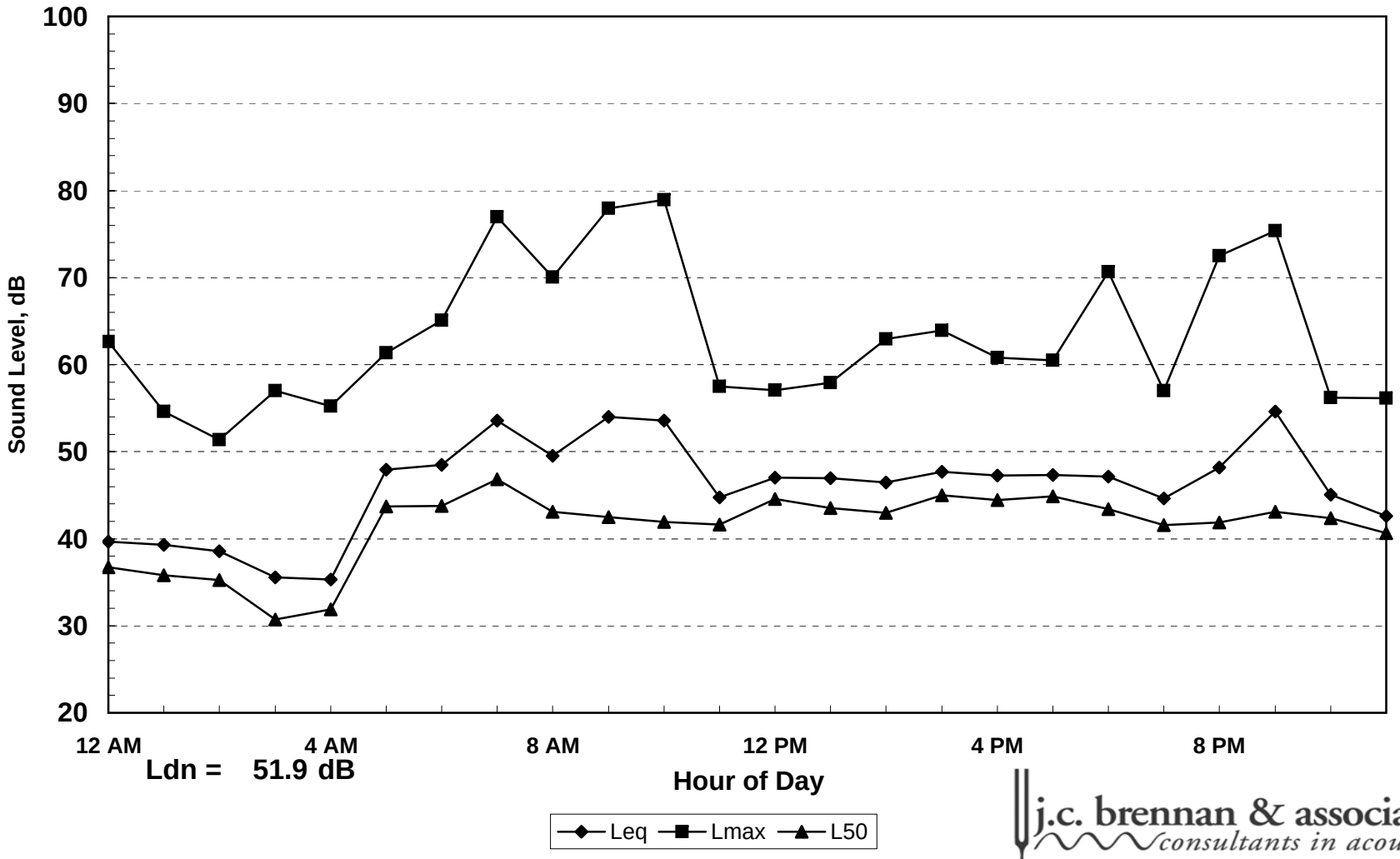
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-1

Monday, April 25, 2011



Ldn = 51.9 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-1
Tuesday, April 26, 2011

Hour	Leq	Lmax	L50	L8
0:00	41.85	55.91	38.13	46.06
1:00	38.68	56.27	36.95	40.88
2:00	39.15	55.02	37.79	40.71
3:00	38.57	56.41	36.76	40.25
4:00	38.08	55.03	35.6	39.05
5:00	45.49	58.78	41.98	50.05
6:00	46.1	63.9	39.94	49.98
7:00	43.99	61.28	40.37	48.22
8:00	47.7	71.05	40.99	49.88
9:00	47.25	65.56	41.58	50.34
10:00	45.23	56.61	42.94	49.31
11:00	47.34	66.25	42.3	50.19
12:00	44.73	64.71	41.23	48.32
13:00	45.78	66.55	41.29	48.87
14:00	45.22	62.55	41.93	48.68
15:00	46.63	69.45	41.02	48.42
16:00	46.43	67.48	41.63	49.77
17:00	45.45	62.23	41.44	49.87
18:00	42.73	56.94	36.29	48.11
19:00	42.27	56.37	37.34	47.55
20:00	48.57	82.08	40.54	49.62
21:00	43.7	56.31	40.29	48.16
22:00	44.85	58.16	43.19	48.02
23:00	45.34	57.76	43.55	48.77

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	48.6	42.3	45.9	46.1	38.1	43.1
Lmax (Maximum)	82.1	56.3	64.4	63.9	55.0	57.5
L50 (Median)	42.9	36.3	40.7	43.6	35.6	39.3
L8	50.3	47.6	49.0	50.1	39.1	44.9

Computed Ldn, dB	50.1
% Daytime Energy	76%
% Nighttime Energy	24%

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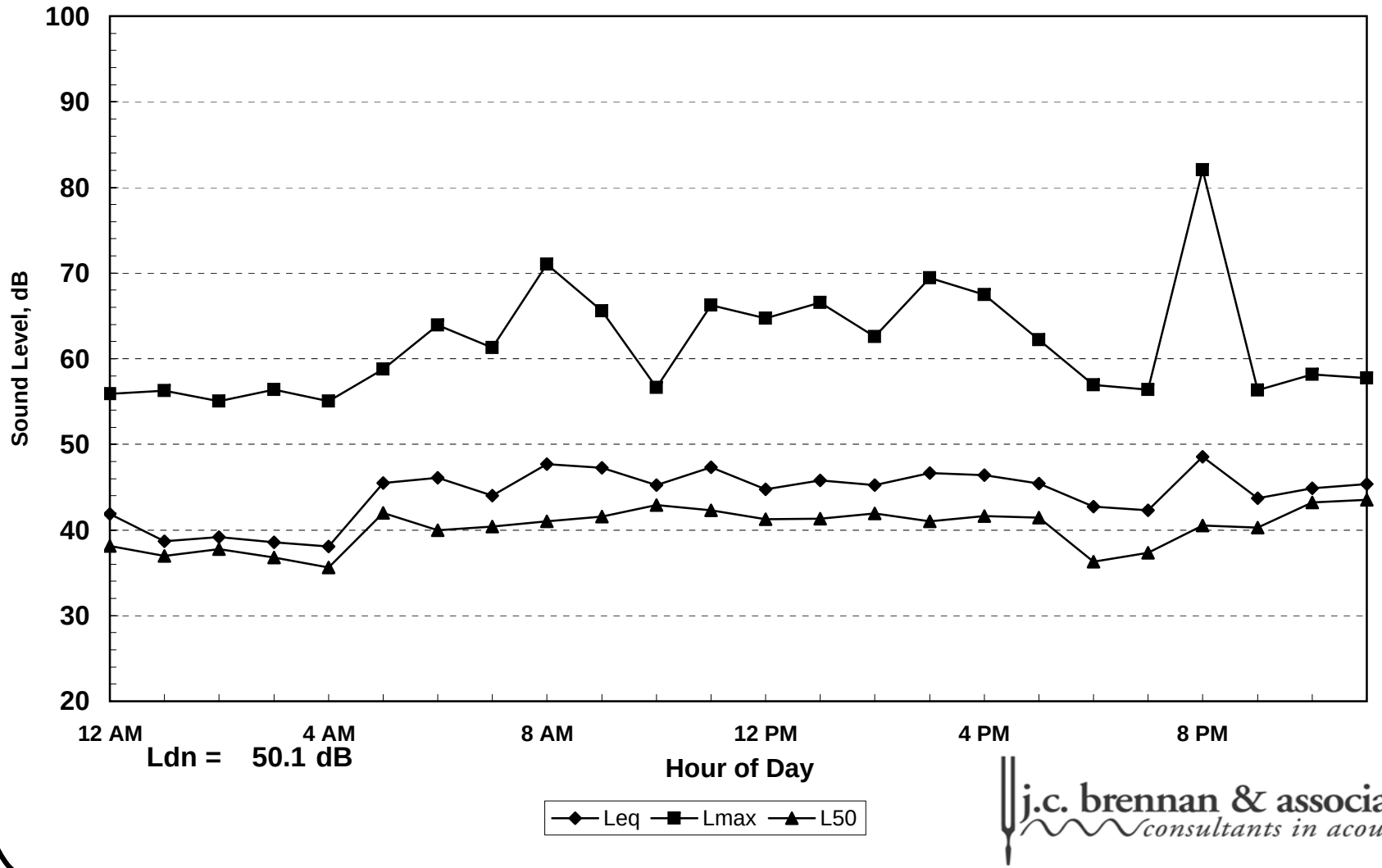
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-1

Tuesday, April 26, 2011



Ldn = 50.1 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-2
Wednesday, April 20, 2011

Hour	Leq	Lmax	L50	L8
0:00	43.74	55.78	42.57	46.6
1:00	42.49	66.78	39.41	43.8
2:00	38.88	55.76	38.05	40.6
3:00	37.44	54.98	35.78	37.98
4:00	49.32	58.6	47.01	53.75
5:00	47.93	61.55	44.44	52.19
6:00	49.18	69.42	44.35	51.73
7:00	54.12	75.07	45	53.72
8:00	47.98	64.91	43.26	51.97
9:00	55.05	81.14	45.13	53.97
10:00	47.84	68.38	42.65	50.63
11:00	52.2	71.21	42.48	53.23
12:00	48.79	70.09	41.51	49.25
13:00	47.61	67.6	42.68	50.72
14:00	48.34	65.95	44.44	51.72
15:00	49.88	70.17	45.72	52.72
16:00	48.89	76	43.69	52.18
17:00	48.39	70.05	43.05	51.21
18:00	46.7	68.02	41.76	49.43
19:00	44.81	66.48	41.26	47.85
20:00	51.05	74.23	40.74	49.58
21:00	43.72	63.96	34.93	47.44
22:00	40.89	56.05	31.09	45.77
23:00	31.84	48.9	26.58	33.13

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	55.1	43.7	50.1	49.3	31.8	45.2
Lmax (Maximum)	81.1	64.0	70.2	69.4	48.9	58.6
L50 (Median)	45.7	34.9	42.6	47.0	26.6	38.8
L8	54.0	47.4	51.0	53.8	33.1	45.1

Computed Ldn, dB	52.8
% Daytime Energy	84%
% Nighttime Energy	16%

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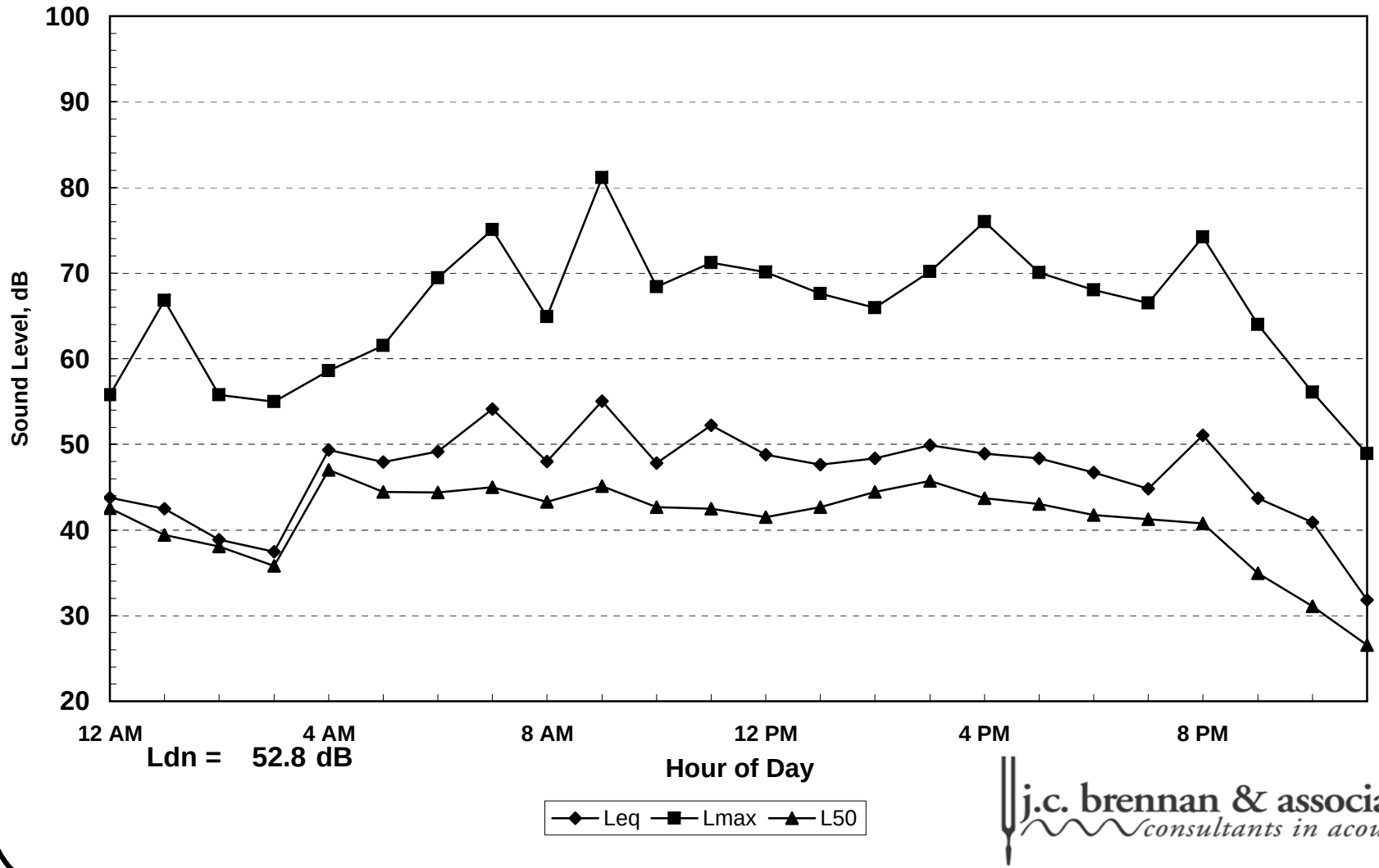
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-2

Wednesday, April 20, 2011



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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-2
Thursday, April 21, 2011

Hour	Leq	Lmax	L50	L8
0:00	36.77	56.73	27.83	40.7
1:00	49.33	65.62	35.54	55.29
2:00	46.93	66.23	36.29	52.98
3:00	36.74	55.19	31.77	38.11
4:00	49.86	68.68	44.49	52.94
5:00	45.02	64.18	39.24	48.79
6:00	50.35	68.89	45.08	53.22
7:00	47.23	62.5	43.46	52.01
8:00	48.33	69.8	44.08	52.65
9:00	50.34	70.22	45.34	52.78
10:00	48.81	71.15	44.61	51.59
11:00	47.88	64.28	42.69	52.14
12:00	51.03	75.85	44.24	51.31
13:00	48.51	73.38	43.06	51.26
14:00	48.51	66.33	44.56	52.35
15:00	48.14	62.77	43.29	52.44
16:00	48.07	68.18	43.31	51.36
17:00	46.05	62.27	43.3	49.32
18:00	46.47	58.76	42.41	51.35
19:00	47.32	60.17	44.83	51.72
20:00	47.1	62.16	42.63	51.74
21:00	46.28	59.64	41.05	50.89
22:00	44.39	59.5	38.01	49.28
23:00	45.1	64.39	40.89	48.33

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	51.0	46.1	48.2	50.4	36.7	46.9
Lmax (Maximum)	75.9	58.8	65.8	68.9	55.2	63.3
L50 (Median)	45.3	41.1	43.5	45.1	27.8	37.7
L8	52.8	49.3	51.7	55.3	38.1	48.8

Computed Ldn, dB	53.5
% Daytime Energy	69%
% Nighttime Energy	31%

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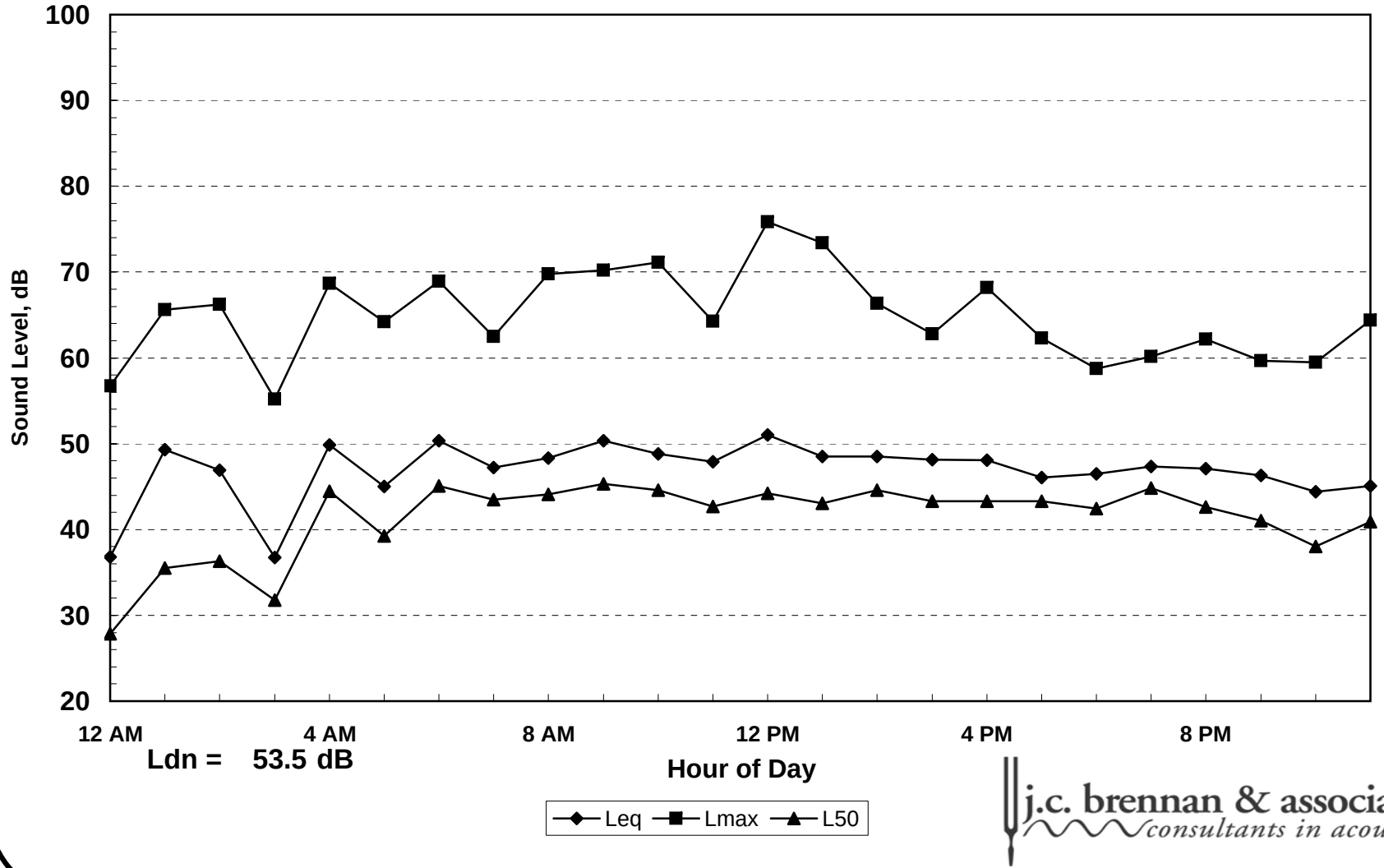
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-2

Thursday, April 21, 2011



Ldn = 53.5 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-2
Friday, April 22, 2011

Hour	Leq	Lmax	L50	L8
0:00	44.93	56.9	43.62	47.78
1:00	46.69	56.78	46.08	48.5
2:00	47.34	59.54	47.01	48.76
3:00	45.91	56.04	45.03	47.96
4:00	50.82	64.77	48.21	54.62
5:00	47.89	63.13	44.33	51.57
6:00	52.22	69.54	44.81	54.47
7:00	49.14	69.05	43.66	53.58
8:00	50.72	66.94	45.64	54.58
9:00	48.3	66.75	43.52	52.55
10:00	47.27	64.78	42.97	49.99
11:00	48.61	72.24	41.84	50.09
12:00	46.02	64.5	41.29	48.53
13:00	50.63	72.47	43.15	51.55
14:00	50.25	70.72	44.27	51.88
15:00	49.72	70.69	45.12	52.5
16:00	46.88	60.87	44.35	50.58
17:00	45.63	59.52	43.75	48.91
18:00	47.62	68.16	43.7	48.75
19:00	45.54	58.62	43.58	49.51
20:00	46.12	59.6	43.63	50.22
21:00	45.61	56.72	42.92	50.03
22:00	48.25	65.38	42.13	51.67
23:00	44.03	57.18	41.19	48.16

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	50.7	45.5	48.3	52.2	44.0	48.3
Lmax (Maximum)	72.5	56.7	65.4	69.5	56.0	61.0
L50 (Median)	45.6	41.3	43.6	48.2	41.2	44.7
L8	54.6	48.5	50.9	54.6	47.8	50.4

Computed Ldn, dB	54.7
% Daytime Energy	62%
% Nighttime Energy	38%

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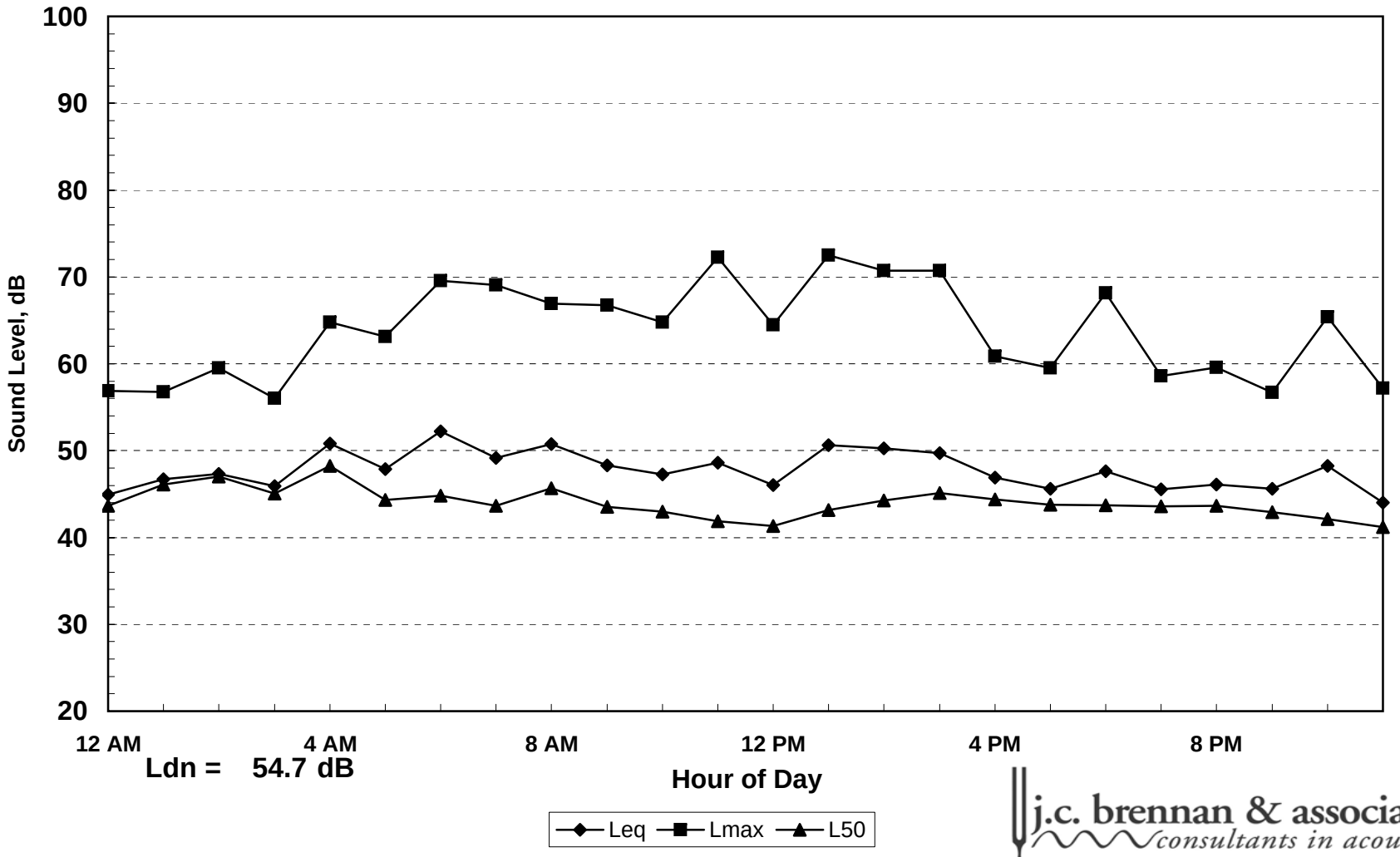
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-2

Friday, April 22, 2011



Ldn = 54.7 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-2
Saturday, April 23, 2011

Hour	Leq	Lmax	L50	L8
0:00	43.47	59.41	34.94	48.44
1:00	42.09	55.39	37.06	47.14
2:00	41.74	58.24	33.28	46.78
3:00	38.76	56.23	33.09	41.73
4:00	47.79	58.58	45.29	52.44
5:00	39.74	55.94	36.19	43.26
6:00	45.35	63.7	41.01	48.82
7:00	46.03	70.59	38.49	48.9
8:00	44.2	62.6	41.05	47.89
9:00	50.75	72.4	42.51	52.97
10:00	49.88	72.37	43.56	52.14
11:00	49.14	67.5	44.5	51.82
12:00	45.9	60.21	43.23	49.95
13:00	47.12	60.89	44.62	50.55
14:00	54.4	77.08	45.11	54.63
15:00	46.16	59.74	43.33	49.95
16:00	46.32	61.33	43.4	50.12
17:00	44.32	59.97	41.88	47.45
18:00	44.53	58.38	42.45	47.86
19:00	49.16	77.15	44.69	51.72
20:00	46.51	57.45	43.85	50.96
21:00	46.48	60.69	42.93	50.97
22:00	45.28	61.02	40.85	50.02
23:00	46.2	58.59	42.4	51.08

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	54.4	44.2	48.4	47.8	38.8	44.3
Lmax (Maximum)	77.2	57.5	65.2	63.7	55.4	58.6
L50 (Median)	45.1	38.5	43.0	45.3	33.1	38.2
L8	54.6	47.5	50.5	52.4	41.7	47.7

Computed Ldn, dB	51.6
% Daytime Energy	81%
% Nighttime Energy	19%

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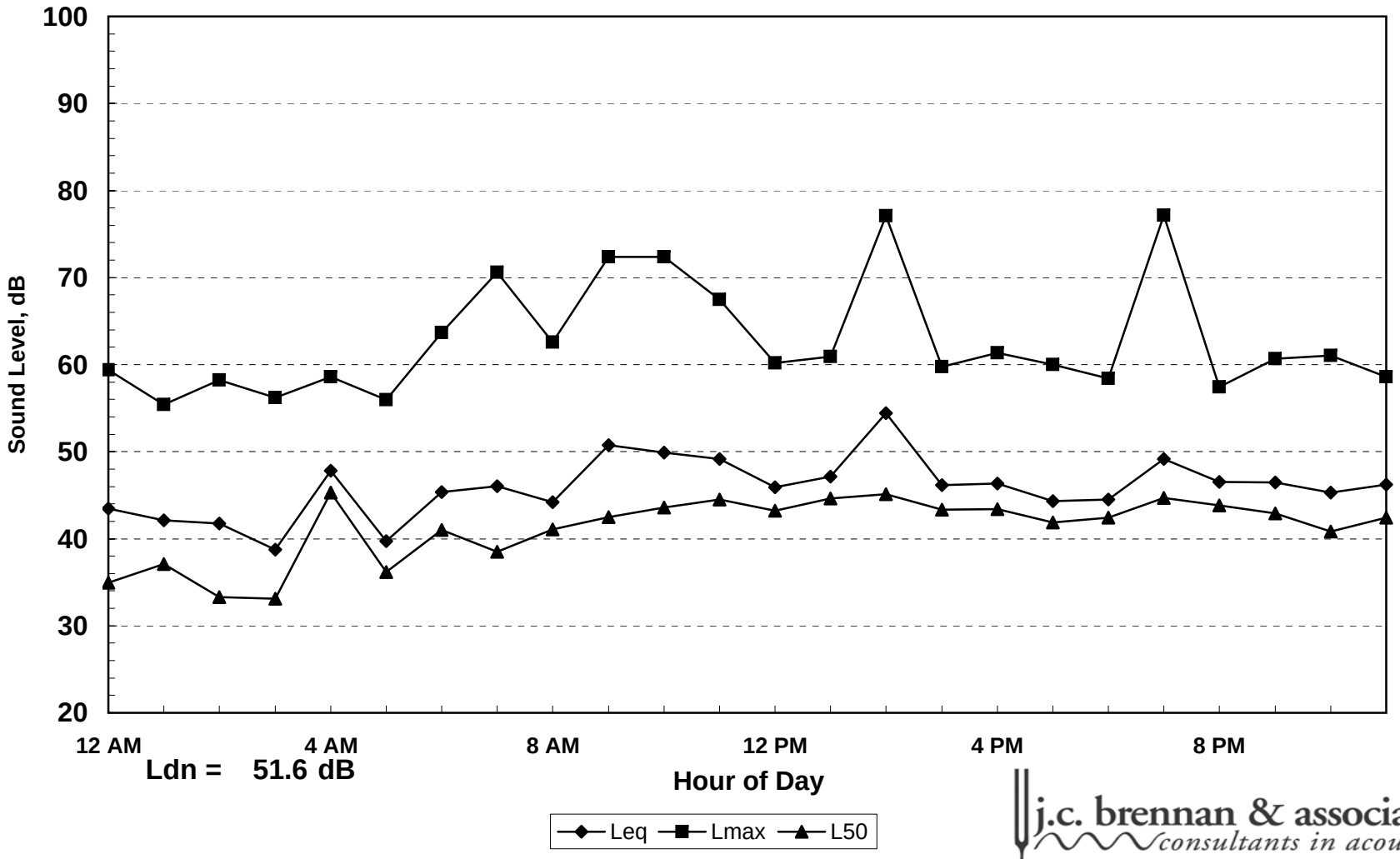
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-2

Saturday, April 23, 2011



Ldn = 51.6 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-2
Sunday, April 24, 2011

Hour	Leq	Lmax	L50	L8
0:00	42.75	56.7	38.57	47.19
1:00	41.61	57.93	31.99	47.45
2:00	41.6	57.65	34.25	46.42
3:00	48.07	59.39	47.67	51.49
4:00	52.35	60.08	52.1	54.91
5:00	53.33	59.52	53.12	55.4
6:00	50.86	66.8	49.43	53.24
7:00	51.44	65.12	49.53	54.38
8:00	50.22	68.01	48.34	53.62
9:00	49.37	64.51	46.27	53.38
10:00	50.62	64.07	48.44	54.42
11:00	51.84	69.28	49.95	54.69
12:00	52.53	68.42	50.75	55.67
13:00	51.07	65.53	48.8	54.67
14:00	52.19	67.12	49.75	55.49
15:00	49.4	61.97	47.75	53.04
16:00	49.68	68.96	45.15	52.77
17:00	48.09	64.8	45.15	52.05
18:00	47.79	66.14	45.28	51.72
19:00	45.76	58.36	41.87	50.37
20:00	47.37	58.58	44.38	51.86
21:00	45.58	57.05	43.61	49.5
22:00	48.37	64.8	44.42	52.53
23:00	45.76	61.04	44	49.39

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	52.5	45.6	50.0	53.3	41.6	49.1
Lmax (Maximum)	69.3	57.1	64.5	66.8	56.7	60.4
L50 (Median)	50.8	41.9	47.0	53.1	32.0	44.0
L8	55.7	49.5	53.2	55.4	46.4	50.9

Computed Ldn, dB	55.6
% Daytime Energy	67%
% Nighttime Energy	33%

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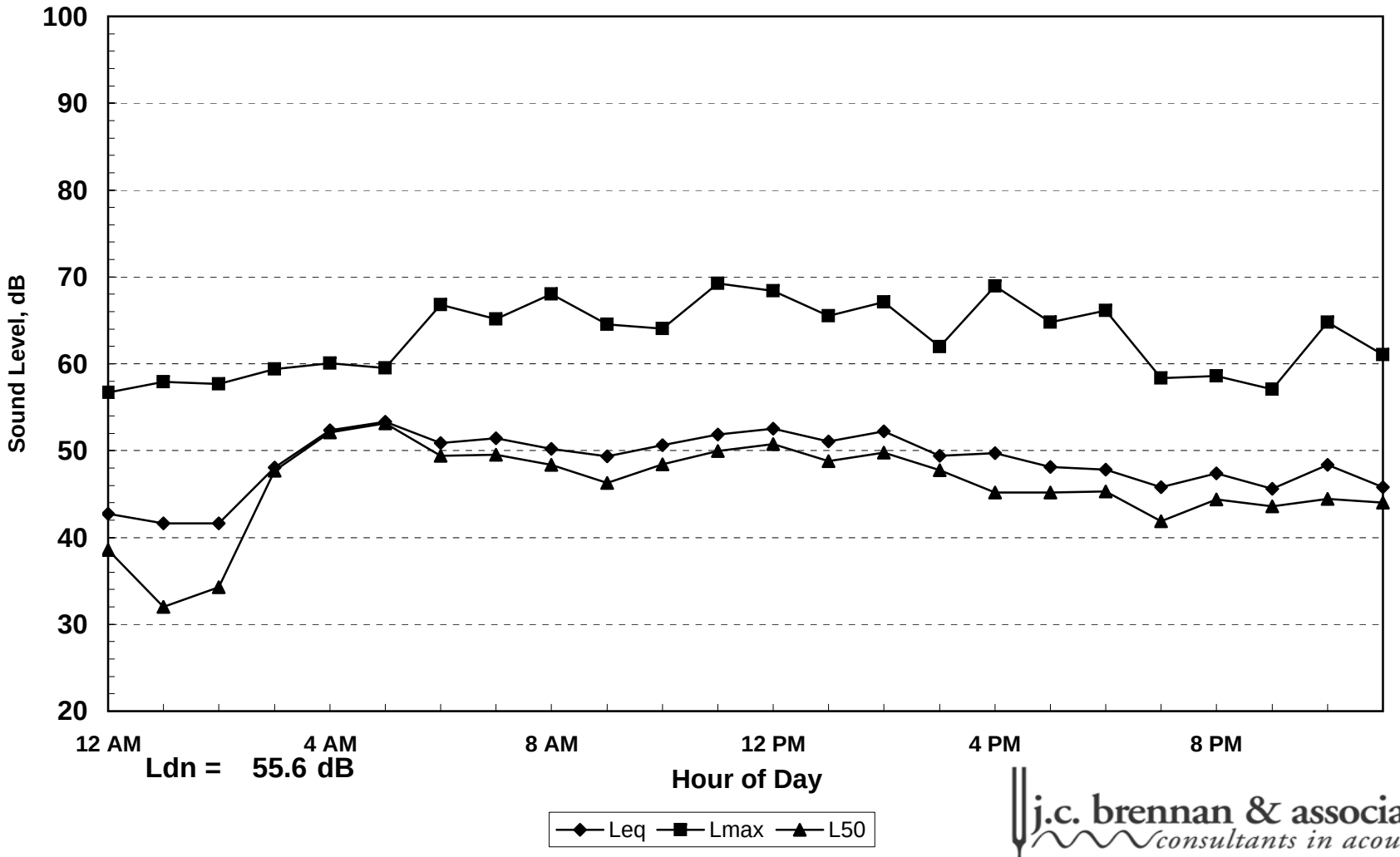
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-2

Sunday, April 24, 2011



Ldn = 55.6 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-2
Monday, April 25, 2011

Hour	Leq	Lmax	L50	L8
0:00	44.74	54.9	43.94	47.27
1:00	43.05	57.9	42.01	46.16
2:00	35.96	54.01	33.91	37.75
3:00	40.62	53.63	38.51	44
4:00	48.39	57.75	46.67	52.76
5:00	46.33	64.99	40.72	50.47
6:00	52.2	65.97	45.94	57.42
7:00	58.87	69.19	57.65	62.31
8:00	60.35	70.76	59.28	64.1
9:00	61.76	71.69	60.9	64.89
10:00	61.19	71.87	60.08	64.96
11:00	57.72	70.9	49.48	63.33
12:00	59.9	70.3	58.75	63.85
13:00	60.62	74.01	60.15	64.05
14:00	59.96	78.47	58.59	63.69
15:00	57.14	69.45	54.39	61.57
16:00	56.3	77.05	54.3	58.03
17:00	55.77	65.43	55.21	58.14
18:00	55.17	65.79	54.5	57.51
19:00	53	68.41	51.78	55.46
20:00	48.21	62.74	46.28	51.87
21:00	46	62.08	42.12	49.94
22:00	46.32	58.82	44.19	50.53
23:00	42.6	55.39	40.39	46.4

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	61.8	46.0	58.4	52.2	36.0	46.5
Lmax (Maximum)	78.5	62.1	69.9	66.0	53.6	58.2
L50 (Median)	60.9	42.1	54.9	46.7	33.9	41.8
L8	65.0	49.9	60.2	57.4	37.8	48.1

Computed Ldn, dB	57.8
% Daytime Energy	96%
% Nighttime Energy	4%

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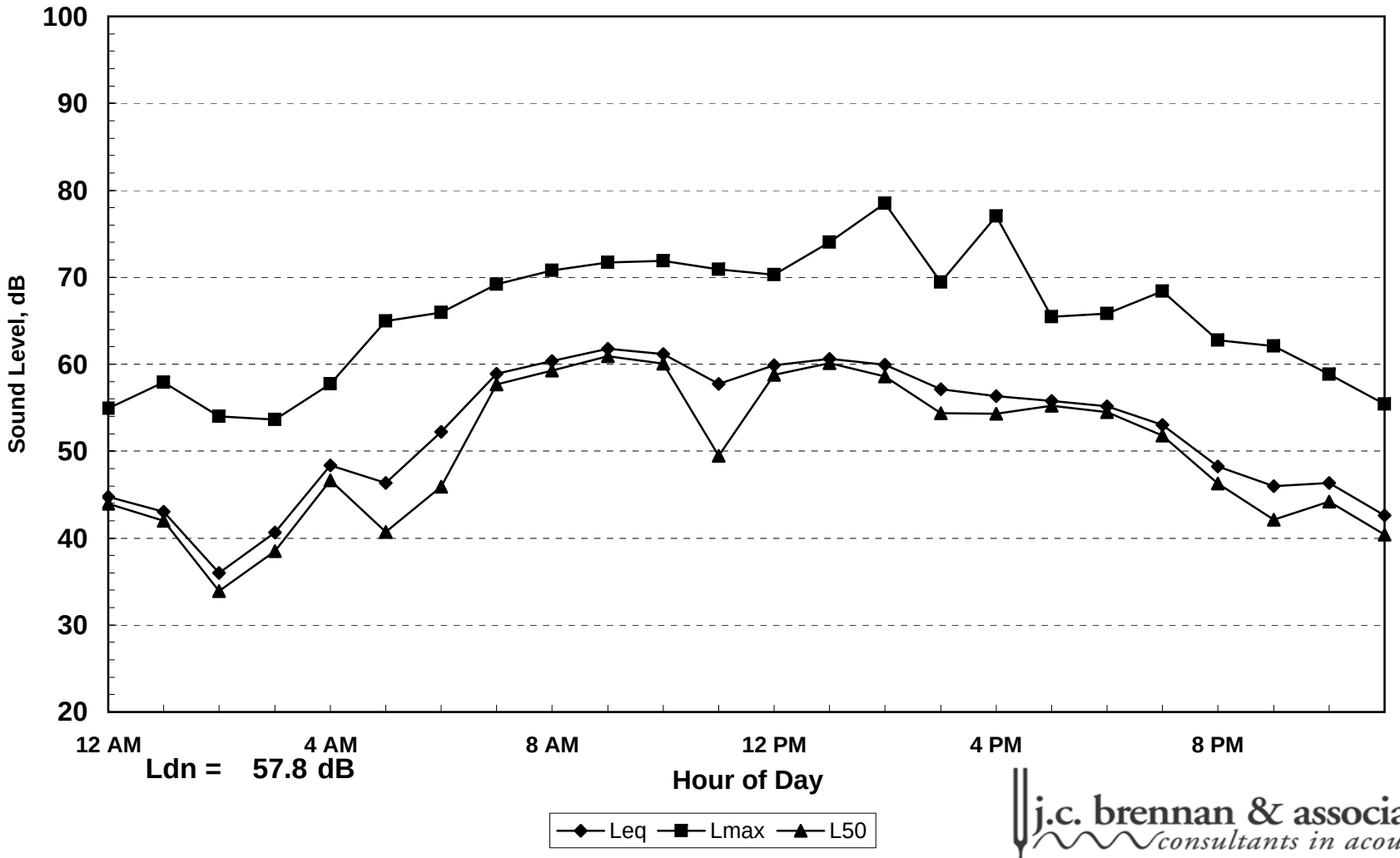
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-2

Monday, April 25, 2011



Ldn = 57.8 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-2
Tuesday, April 26, 2011

Hour	Leq	Lmax	L50	L8
0:00	42.2	61.33	37.44	45.95
1:00	48.72	60.69	48.12	51.3
2:00	46.97	59.2	45.64	49.6
3:00	47.76	63.58	46	50.12
4:00	50.25	64.44	48.26	53.56
5:00	49.62	72.94	45.49	52.72
6:00	53.54	70.19	48.33	57.06
7:00	51.94	67.72	48.92	55.83
8:00	51.77	65.14	49.72	55.14
9:00	52.75	68.94	50.85	56.38
10:00	52.21	70.83	49.44	55.44
11:00	52.8	70.39	47.04	55.38
12:00	48.8	62.3	46.43	52.72
13:00	48.96	70.6	45.9	52.8
14:00	49.88	65.3	45.95	53.87
15:00	49.98	64.16	47.08	53.53
16:00	50.39	68.42	46.58	53.74
17:00	45.25	56.85	43.22	49.26
18:00	46.3	62.37	42.53	49.32
19:00	45.19	63.8	42.19	48.72
20:00	43.98	56.99	41.08	48.29
21:00	45.88	62.83	42.67	49.7
22:00	45.68	64.03	41.62	49.13
23:00	45.48	62.89	39.91	49.87

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	52.8	44.0	50.0	53.5	42.2	48.9
Lmax (Maximum)	70.8	56.9	65.1	72.9	59.2	64.4
L50 (Median)	50.9	41.1	46.0	48.3	37.4	44.5
L8	56.4	48.3	52.7	57.1	46.0	51.0

Computed Ldn, dB	55.5
% Daytime Energy	68%
% Nighttime Energy	32%

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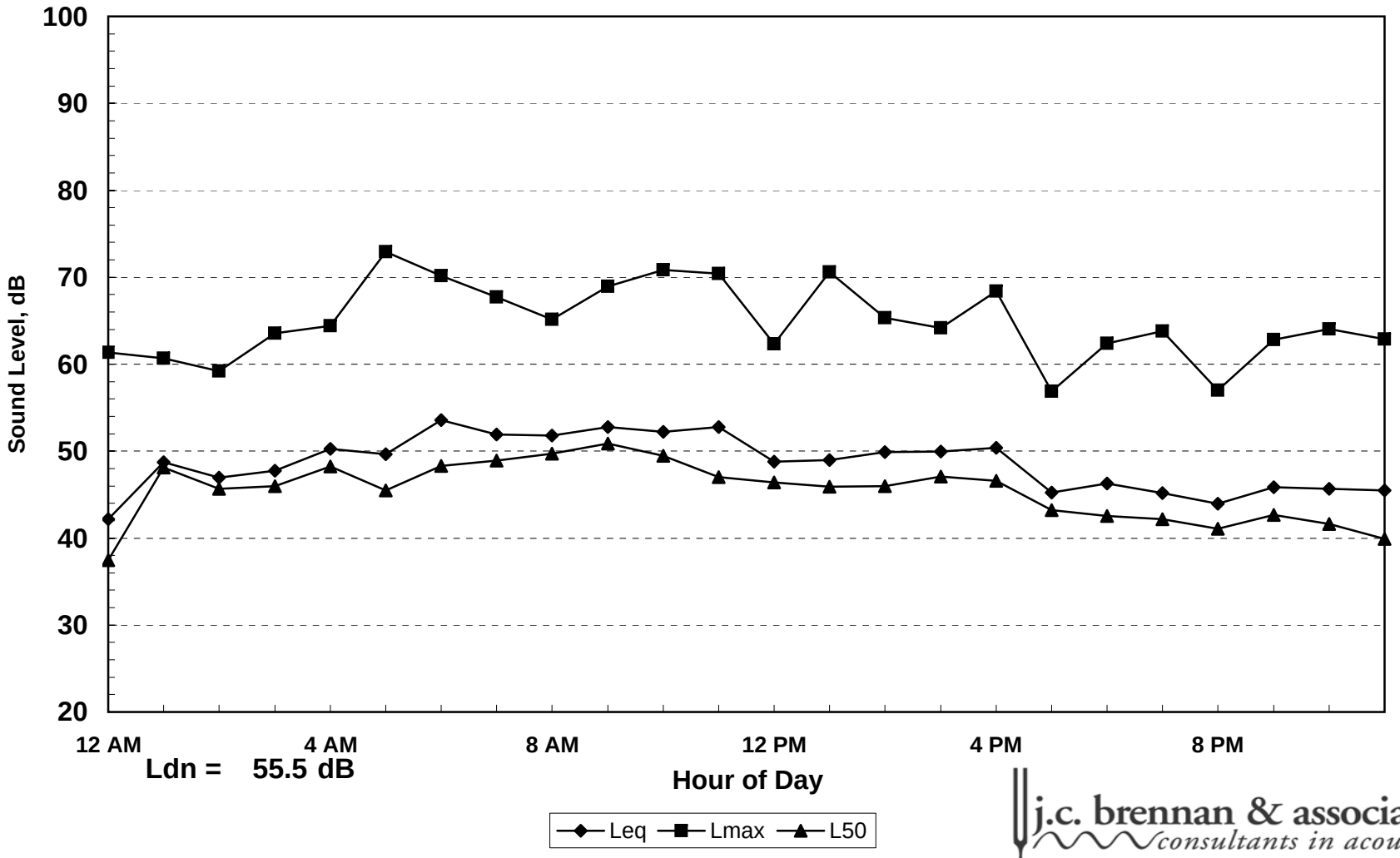
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-2

Tuesday, April 26, 2011



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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-3
Wednesday, April 20, 2011

Hour	Leq	Lmax	L50	L8
0:00	43.76	51.37	43.26	46.29
1:00	39.72	51.23	38.59	42.66
2:00	37.27	51.46	35.38	40.04
3:00	34.35	47.58	31.85	38.12
4:00	33.45	45.94	31.37	36.87
5:00	46.35	58.42	44.25	49.61
6:00	50.02	74.79	44.65	52.94
7:00	47.57	61.78	44.72	51.16
8:00	51.85	78.58	43.44	49.72
9:00	47.44	68.21	41.97	49.6
10:00	46.47	58.99	42.57	51.23
11:00	51.23	79.29	40.76	51.47
12:00	56.48	86.34	39.9	51.11
13:00	46.67	65.3	38.54	49.94
14:00	46.87	74.93	40.01	49.92
15:00	45.44	68.14	36.72	42.95
16:00	46.6	72.29	40.63	49.64
17:00	49.34	71.23	37.48	45.2
18:00	45	63.66	39.9	49.34
19:00	39.54	55.89	36.41	41.96
20:00	45.8	67.65	39.87	46.19
21:00	52.19	76.05	47.57	51.3
22:00	44.48	58.13	44.19	46.26
23:00	42.86	55.35	42.19	45.45

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	56.5	39.5	49.7	50.0	33.5	44.2
Lmax (Maximum)	86.3	55.9	69.9	74.8	45.9	54.9
L50 (Median)	47.6	36.4	40.7	44.7	31.4	39.5
L8	51.5	42.0	48.7	52.9	36.9	44.2

Computed Ldn, dB	51.9
% Daytime Energy	86%
% Nighttime Energy	14%

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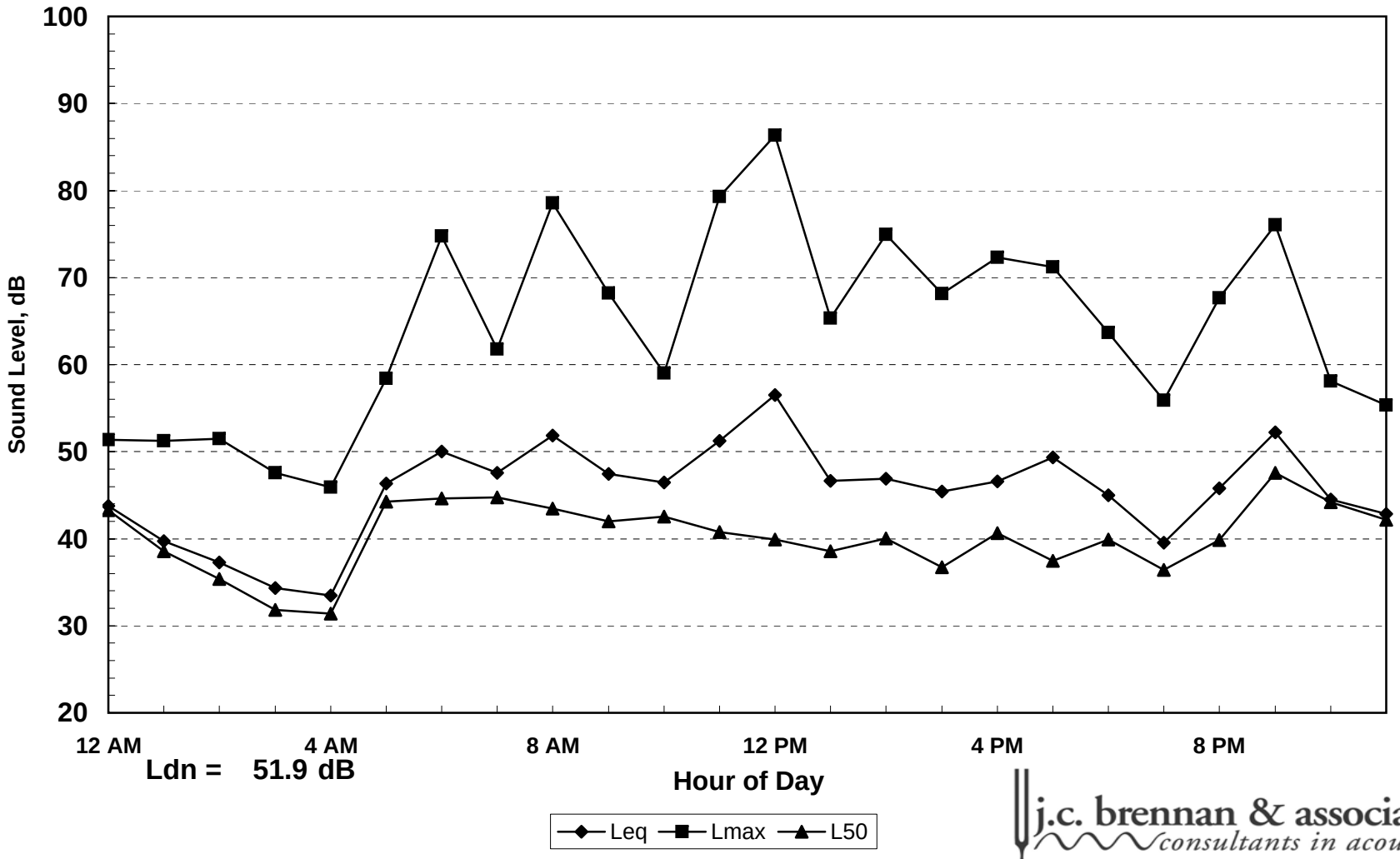
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-3

Wednesday, April 20, 2011



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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-3
Thursday, April 21, 2011

Hour	Leq	Lmax	L50	L8
0:00	39.57	47.69	38.72	42.48
1:00	37.06	45.79	35.59	40.43
2:00	34.51	55.16	31.42	36.48
3:00	38.76	56.16	35.4	41.36
4:00	35.86	49.04	32.92	39.69
5:00	47.37	58.6	44.76	51.19
6:00	48.51	72.79	42.87	50.75
7:00	49.04	75.67	44.04	49.27
8:00	48.76	70.07	43.13	50.87
9:00	46.09	61.58	42.15	47.44
10:00	46.37	71.38	41.49	47.04
11:00	43.02	61.79	39.96	45.63
12:00	46.23	69.29	38.26	44.97
13:00	43.62	61.32	39.4	46.68
14:00	53.39	77.66	40.01	53.05
15:00	46.72	70.72	38.29	51.22
16:00	52.99	75.65	43.83	48.22
17:00	44.47	59.62	42.62	47.08
18:00	42.57	60.13	40.32	45.14
19:00	44.54	62.12	43.19	47.17
20:00	47.12	67.34	44.51	48.4
21:00	47.9	52.05	47.72	49.64
22:00	47.44	61.69	46.97	49.28
23:00	43.81	56.42	43	45.82

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	53.4	42.6	48.1	48.5	34.5	44.1
Lmax (Maximum)	77.7	52.1	66.4	72.8	45.8	55.9
L50 (Median)	47.7	38.3	41.9	47.0	31.4	39.1
L8	53.1	45.0	48.1	51.2	36.5	44.2

Computed Ldn, dB	51.4
% Daytime Energy	81%
% Nighttime Energy	19%

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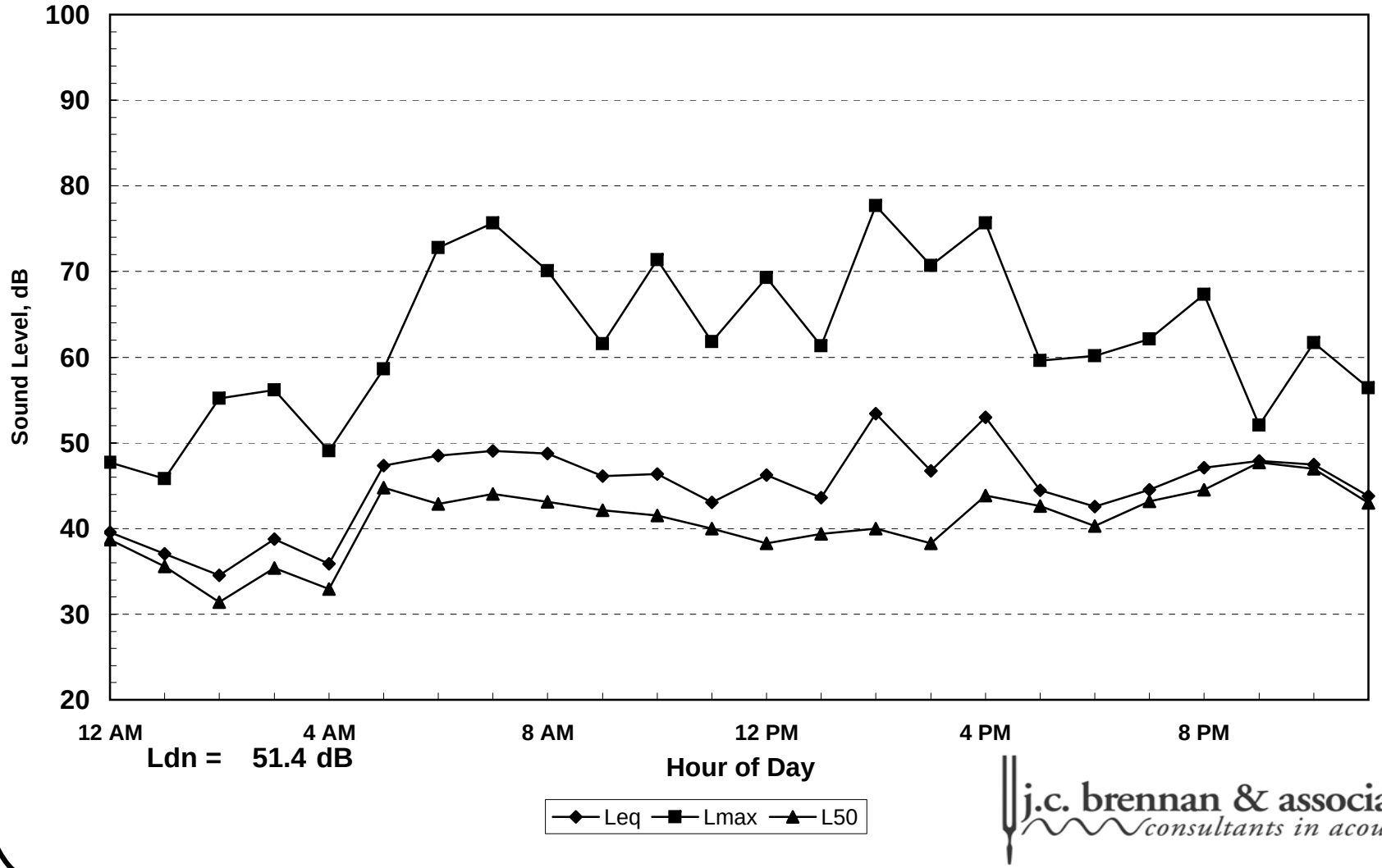
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-3

Thursday, April 21, 2011



Ldn = 51.4 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-3
Friday, April 22, 2011

Hour	Leq	Lmax	L50	L8
0:00	38.81	50.05	37.54	41.98
1:00	37.12	45.06	36	40.16
2:00	35.13	45.31	32.35	39.2
3:00	35.64	47.06	33.46	39.23
4:00	34.85	46.82	32.35	38.51
5:00	47.14	58.29	44.28	51.3
6:00	49.2	63.39	45.95	53.26
7:00	50.07	67.76	47.58	53.22
8:00	49.78	67.27	45.99	53.48
9:00	49.39	65.51	46.76	53.05
10:00	48.27	70.54	41.11	49.46
11:00	49.21	70.82	39.92	50.86
12:00	59.35	86.51	42.05	51.17
13:00	45.13	62.58	39.02	48.51
14:00	51.39	76.11	40.27	50.43
15:00	49.66	74.04	39.42	47.37
16:00	46.04	69.52	38.95	47.37
17:00	42.94	65.36	38.72	44.2
18:00	54.22	76.09	37.92	46.37
19:00	52.27	75.2	41.58	48.54
20:00	45.12	57	43.11	48.85
21:00	51.28	66.72	51.19	52.87
22:00	52.12	56.28	51.76	53.97
23:00	48.01	52.87	47.98	49.85

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	59.4	42.9	51.7	52.1	34.9	46.3
Lmax (Maximum)	86.5	57.0	70.1	63.4	45.1	51.7
L50 (Median)	51.2	37.9	42.2	51.8	32.4	40.2
L8	53.5	44.2	49.7	54.0	38.5	45.3

Computed Ldn, dB	54.0
% Daytime Energy	85%
% Nighttime Energy	15%

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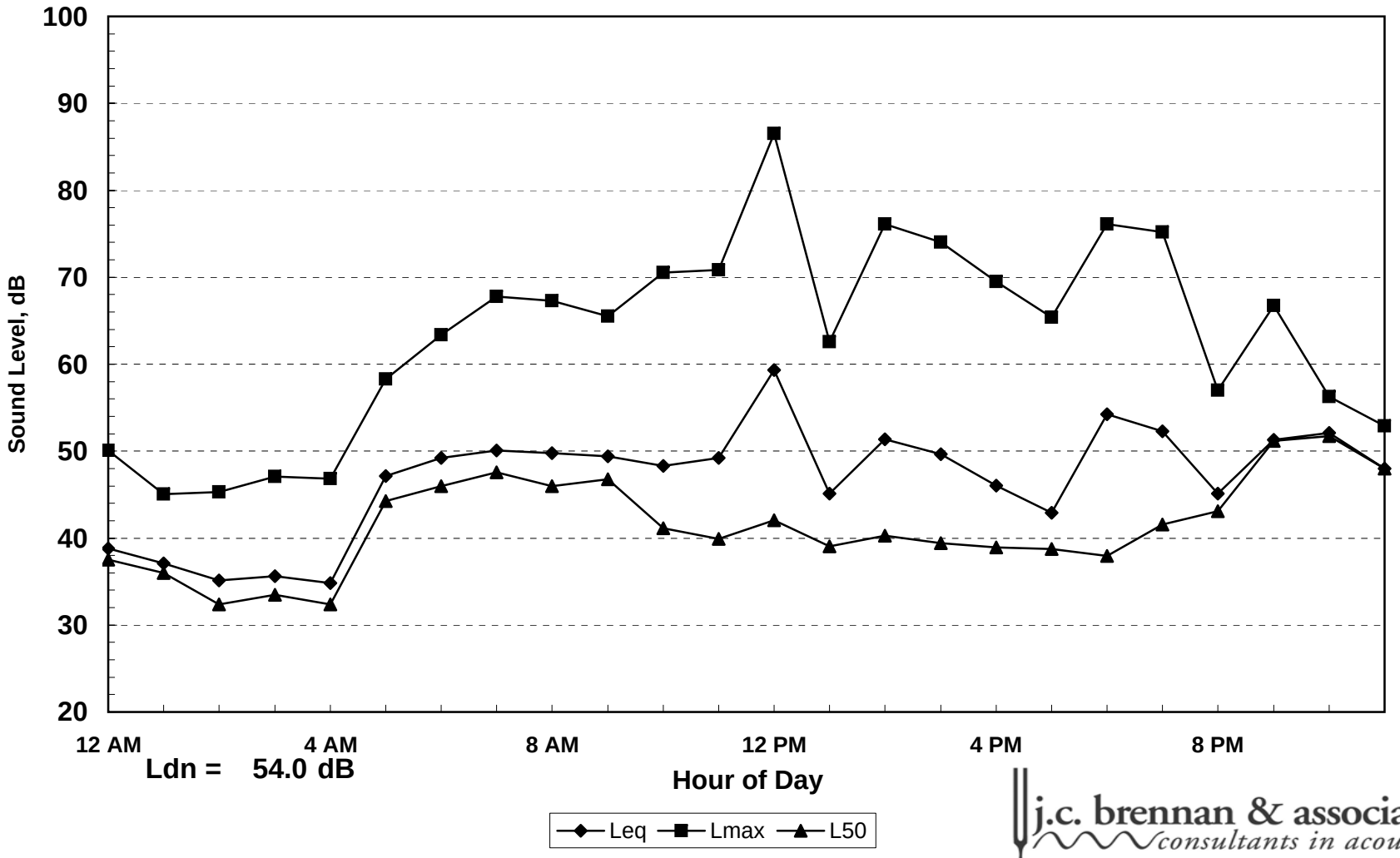
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-3

Friday, April 22, 2011



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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-3
Saturday, April 23, 2011

Hour	Leq	Lmax	L50	L8
0:00	46.62	60.34	45.69	48.9
1:00	45.06	50.9	44.44	47.81
2:00	40.9	60.51	40.29	42.97
3:00	38.9	48.36	37.59	41.94
4:00	35.55	46.47	34.43	38.38
5:00	47.22	62.97	45.2	50.26
6:00	48.47	63.85	44.08	53.12
7:00	47.52	61.67	43.93	51.6
8:00	47.83	60.65	43.14	52.51
9:00	49	66.64	43.12	53.24
10:00	48.39	65.41	42.76	52.78
11:00	54.97	82.83	38.54	51.9
12:00	52.15	76.31	38.44	47.37
13:00	46.15	67.09	39.17	48.21
14:00	46.37	67.37	40.14	48.76
15:00	46.93	70.08	40.09	47.29
16:00	46.46	63.72	40.25	49.12
17:00	44.13	65.03	40.01	46.42
18:00	43.83	66.53	38.91	43.7
19:00	47.3	66.59	41.37	48.68
20:00	46.13	65.72	44.19	48.24
21:00	51.71	55.05	51.66	53.39
22:00	52	56.43	51.79	53.5
23:00	48.52	55.23	47.84	50.83

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	55.0	43.8	49.1	52.0	35.6	47.0
Lmax (Maximum)	82.8	55.1	66.7	63.9	46.5	56.1
L50 (Median)	51.7	38.4	41.7	51.8	34.4	43.5
L8	53.4	43.7	49.5	53.5	38.4	47.5

Computed Ldn, dB	53.8
% Daytime Energy	73%
% Nighttime Energy	27%

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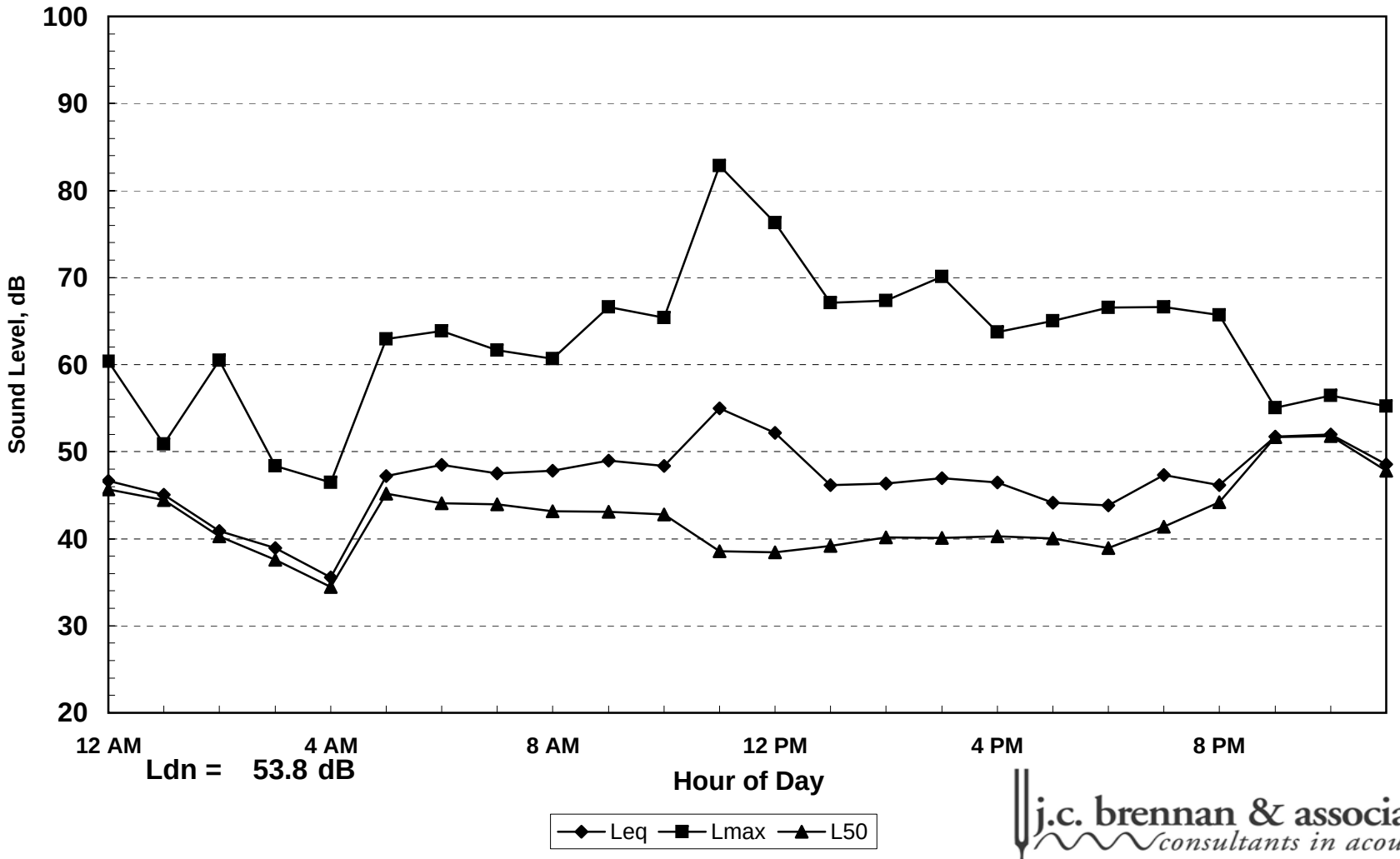
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-3

Saturday, April 23, 2011



Ldn = 53.8 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-3
Sunday, April 24, 2011

Hour	Leq	Lmax	L50	L8
0:00	45.71	51.37	45.33	47.72
1:00	43.57	50.07	43.14	45.65
2:00	43.14	52.86	42.42	46
3:00	37.78	48.29	36.77	40.22
4:00	37.35	51.65	34.87	41.06
5:00	47.83	59.86	45.32	51.65
6:00	48.27	58.26	45.84	52.34
7:00	47.94	59.72	45.97	51.55
8:00	48.74	67.28	44.02	50.95
9:00	45.69	56.74	44.06	48.71
10:00	47.97	70.08	44.34	49.87
11:00	47.15	64.12	44.84	49.86
12:00	51.48	73.69	46.62	52.93
13:00	46.34	62.98	44.8	48.64
14:00	47.42	64.62	45.78	49.63
15:00	49.14	67.82	45	50.26
16:00	45.26	61.52	42.66	48.41
17:00	46.37	69.11	41.45	46.83
18:00	46.71	67.33	44.34	47.75
19:00	44.12	63.7	42.47	46.43
20:00	45.25	67	41.58	46.31
21:00	48.47	68.12	45.32	48.83
22:00	46.65	58.59	45.32	49.62
23:00	46.97	54.21	46.05	49.85

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	51.5	44.1	47.6	48.3	37.4	45.5
Lmax (Maximum)	73.7	56.7	65.6	59.9	48.3	53.9
L50 (Median)	46.6	41.5	44.2	46.1	34.9	42.8
L8	52.9	46.3	49.1	52.3	40.2	47.1

Computed Ldn, dB	52.2
% Daytime Energy	73%
% Nighttime Energy	27%

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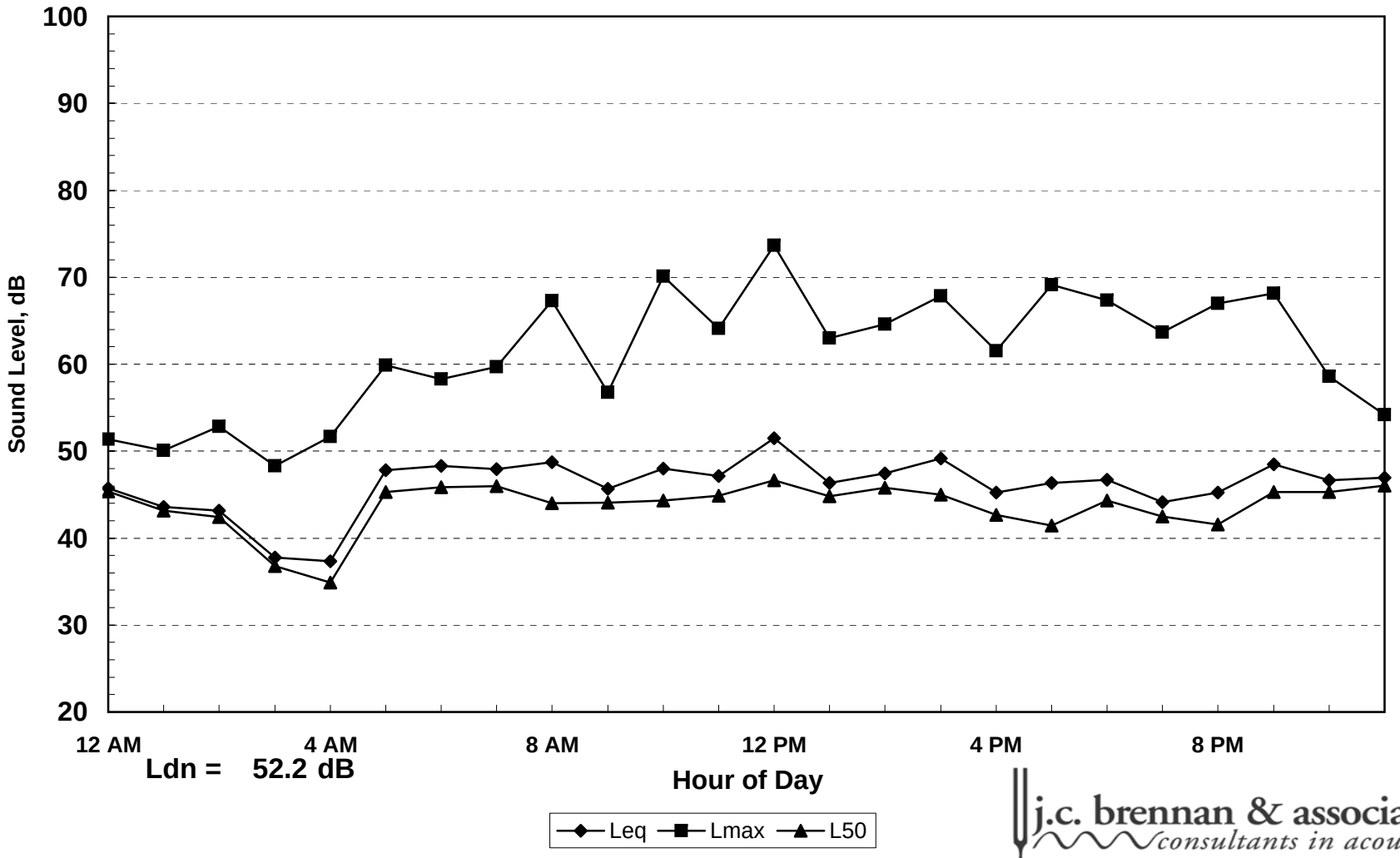
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-3

Sunday, April 24, 2011



Ldn = 52.2 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-3
Monday, April 25, 2011

Hour	Leq	Lmax	L50	L8
0:00	39.54	47.95	38.9	41.97
1:00	44.47	58.32	39.84	47.27
2:00	39.25	51.69	37.71	42.3
3:00	35.64	52.8	33.55	38.85
4:00	34.51	54.93	31.44	37.44
5:00	48.15	71.67	42.79	52.15
6:00	49.44	66.27	45.99	53.62
7:00	51.11	75.77	45.36	53.73
8:00	50.69	70.54	44.69	53.53
9:00	52.83	74.18	43.67	53.32
10:00	50.47	74.46	42.07	52.53
11:00	43.9	62.91	38.47	47.94
12:00	45.65	65.74	40.36	48.01
13:00	47.44	65.36	44.24	49.67
14:00	47.25	61.64	45.44	49.76
15:00	48.09	57.42	47.23	50.68
16:00	48.97	60.65	47.89	51.29
17:00	48.12	60.38	47.5	50.33
18:00	48.08	66	46.76	49.85
19:00	46.74	63.97	45.18	48.92
20:00	46.69	65.22	44.77	48.58
21:00	56.44	77.43	46.76	52.72
22:00	46.85	65.25	45.84	48.86
23:00	44.13	52.85	43.46	46.41

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	56.4	43.9	50.1	49.4	34.5	44.9
Lmax (Maximum)	77.4	57.4	66.8	71.7	48.0	58.0
L50 (Median)	47.9	38.5	44.7	46.0	31.4	39.9
L8	53.7	47.9	50.7	53.6	37.4	45.4

Computed Ldn, dB	52.6
% Daytime Energy	85%
% Nighttime Energy	15%

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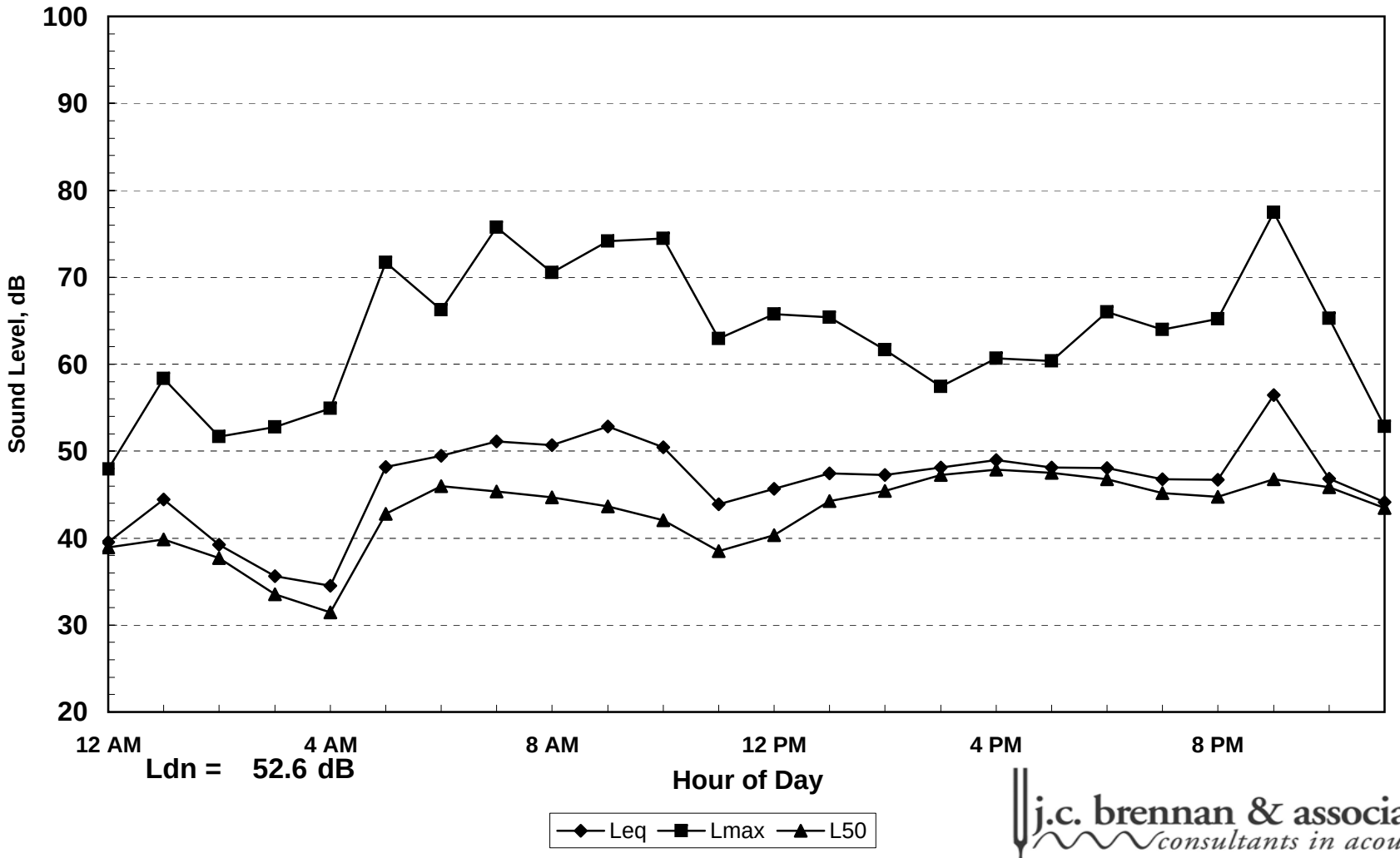
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-3

Monday, April 25, 2011



Ldn = 52.6 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-3
Tuesday, April 26, 2011

Hour	Leq	Lmax	L50	L8
0:00	42.73	59.22	40.69	44.52
1:00	40.54	56.72	39.03	43.62
2:00	41.15	53.48	40.01	43.66
3:00	40.69	51.49	39.59	43.19
4:00	40.8	51.74	39.58	43.58
5:00	49.9	64.97	44.93	53.47
6:00	51.01	71.6	45.27	54.08
7:00	48.6	62.37	46.84	51.68
8:00	49.37	67.65	47.15	51.61
9:00	50.76	77.19	47.03	51.4
10:00	48.02	63.58	46.05	50.79
11:00	47.76	64.97	45.45	50.27
12:00	47.14	59.62	44.54	50.58
13:00	47.22	72.08	42.94	49.74
14:00	49.06	79.07	44.81	48.62
15:00	46.55	57.98	45.22	49.59
16:00	47.9	67.6	43.19	48.8
17:00	44.04	60.86	41.74	46.32
18:00	42.93	59.94	41.4	45.7
19:00	40.79	59.98	38.12	43.07
20:00	47.62	80.49	39.34	49.05
21:00	52	57.69	52.02	53.68
22:00	50.92	69.4	50.01	52.56
23:00	47.02	57.2	46.95	48.98

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	52.0	40.8	48.1	51.0	40.5	47.1
Lmax (Maximum)	80.5	57.7	66.1	71.6	51.5	59.5
L50 (Median)	52.0	38.1	44.4	50.0	39.0	42.9
L8	53.7	43.1	49.4	54.1	43.2	47.5

Computed Ldn, dB	53.7
% Daytime Energy	68%
% Nighttime Energy	32%

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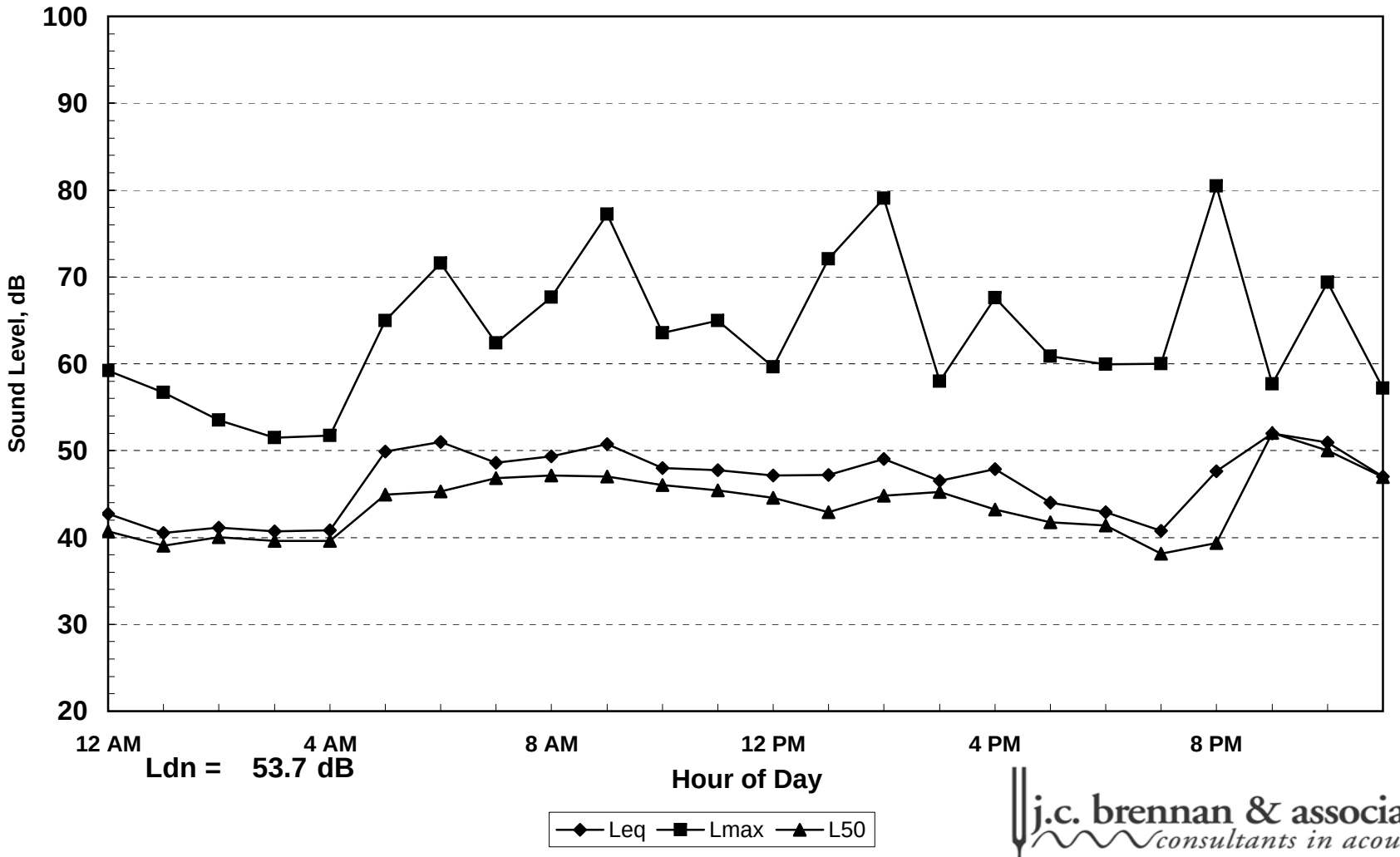
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-3

Tuesday, April 26, 2011



Ldn = 53.7 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-4
Thursday, April 28, 2011

Hour	Leq	Lmax	L50	L8
0:00	46.52	54.64	45.15	49.55
1:00	43.03	57.51	41.68	45.64
2:00	42.96	54.39	42.15	45.72
3:00	44.76	52.01	44.48	47.73
4:00	43.43	52.52	42.89	45.28
5:00	45.85	53.39	43.92	50.02
6:00	46.71	55.89	45.29	50.11
7:00	45.65	59.39	44.15	48.47
8:00	49.76	61.28	49.29	52.03
9:00	45.83	57.93	44.51	48.19
10:00	44.87	57.33	43.58	47.4
11:00	45.01	56.86	42.42	49.11
12:00	45.46	55.17	42.83	49.29
13:00	44.9	61.41	41.78	47.05
14:00	42.01	56.43	40	45.02
15:00	44.64	60.97	42.42	46.88
16:00	44.08	58.23	41.52	46.94
17:00	45.17	56.83	42.07	49.48
18:00	48.97	76.15	43.65	49.78
19:00	42.57	57.4	39.79	46.11
20:00	43.5	58.83	42.42	46.54
21:00	39.57	56.28	36.68	42.42
22:00	42.61	66.09	34.38	44.18
23:00	36.39	52.83	31.74	40

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	49.8	39.6	45.5	46.7	36.4	44.3
Lmax (Maximum)	76.2	55.2	59.4	66.1	52.0	55.5
L50 (Median)	49.3	36.7	42.5	45.3	31.7	41.3
L8	52.0	42.4	47.6	50.1	40.0	46.5

Computed Ldn, dB	50.9
% Daytime Energy	68%
% Nighttime Energy	32%

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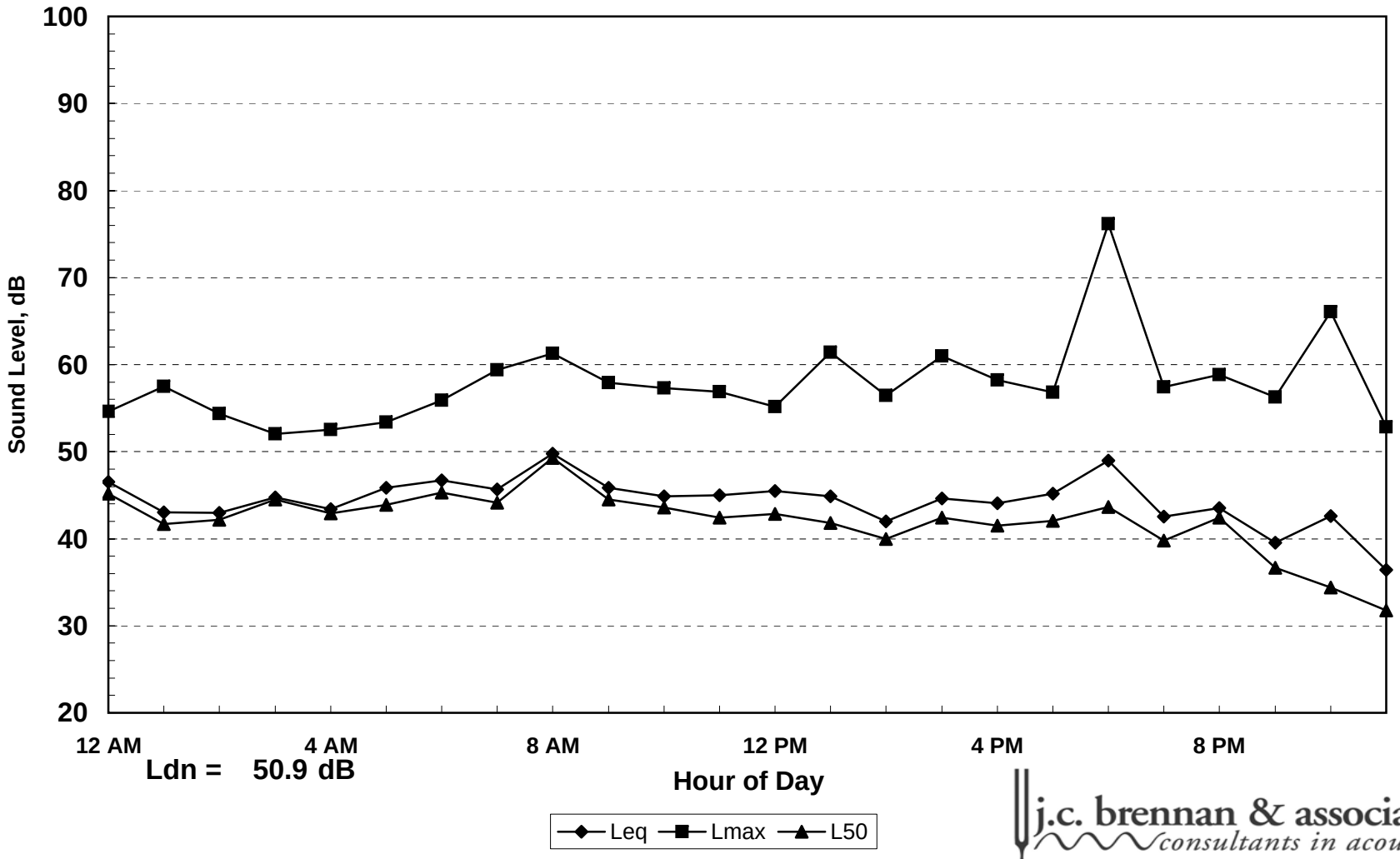
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-4

Thursday, April 28, 2011



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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-4
Friday, April 29, 2011

Hour	Leq	Lmax	L50	L8
0:00	36.22	54.68	30.84	39.97
1:00	32.33	47.4	28.04	34.92
2:00	32.15	46.15	28.74	34.6
3:00	31.89	53.02	28.63	34.03
4:00	31.13	48.01	28.79	32.58
5:00	42.76	55.01	35.55	49.19
6:00	41.43	58.28	38.18	44.04
7:00	45.55	67.79	39.84	46.13
8:00	47.5	62.44	44.59	50.51
9:00	43.39	56.1	41.28	46.51
10:00	47.89	67.86	43.3	51.17
11:00	43.26	59.31	40.44	46.14
12:00	45.68	59.91	42.48	49.7
13:00	47.33	63.94	44.49	48.78
14:00	46.43	59.73	44.92	49.32
15:00	47.18	61.79	44.6	50.25
16:00	45.17	62.22	41.4	47.98
17:00	43.85	58.54	42.4	46.69
18:00	44.61	61.79	39.69	47.06
19:00	46.31	65.58	41.74	49.64
20:00	39.92	52.26	37.12	43.35
21:00	43.04	54.83	38.59	48.53
22:00	38.81	53.31	36.06	42.38
23:00	43.26	55.26	37.4	48.57

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	47.9	39.9	45.6	43.3	31.1	39.0
Lmax (Maximum)	67.9	52.3	60.9	58.3	46.2	52.3
L50 (Median)	44.9	37.1	41.8	38.2	28.0	32.5
L8	51.2	43.4	48.1	49.2	32.6	40.0

Computed Ldn, dB	47.2
% Daytime Energy	88%
% Nighttime Energy	12%

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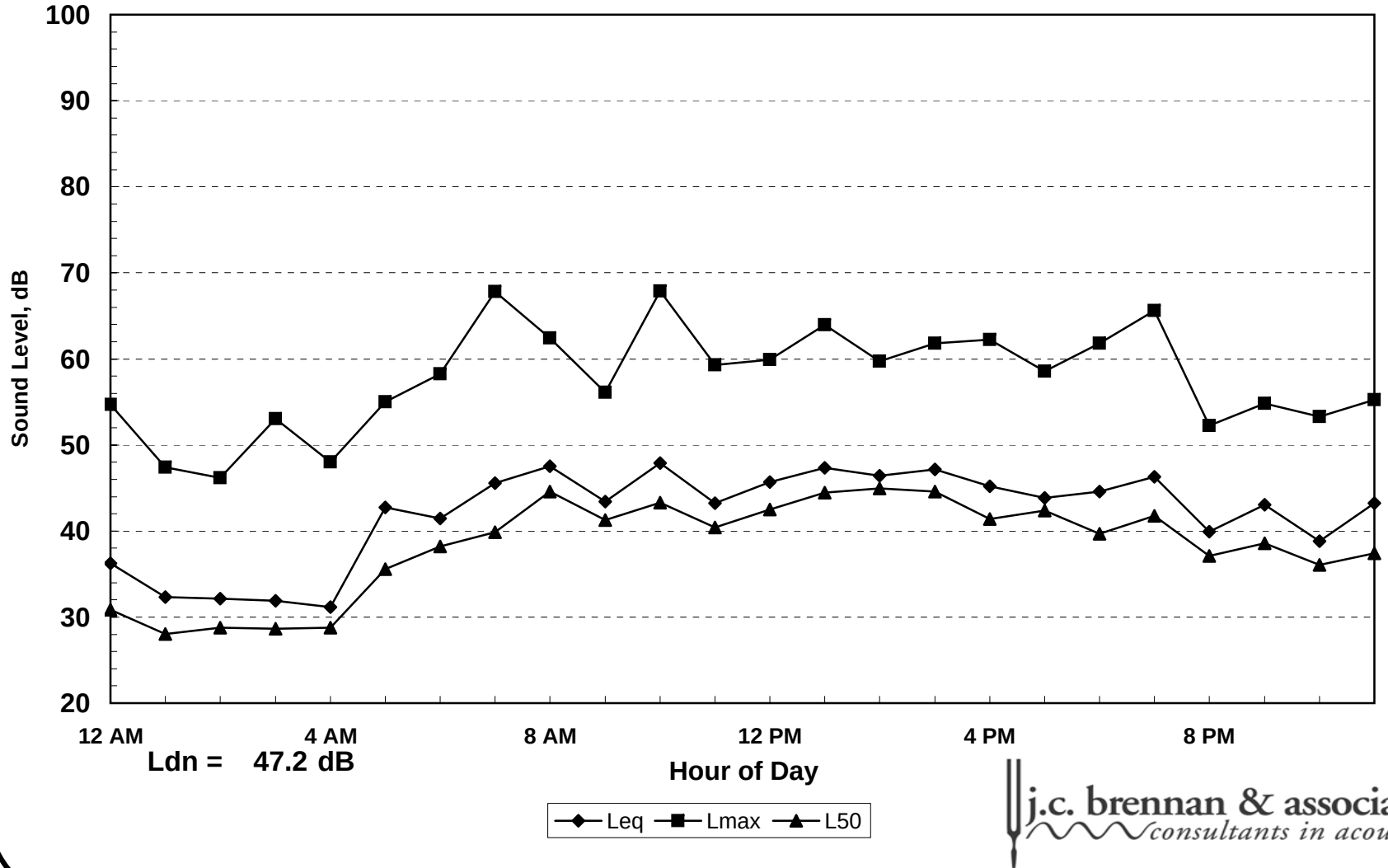
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-4

Friday, April 29, 2011



Ldn = 47.2 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-4
Saturday, April 30, 2011

Hour	Leq	Lmax	L50	L8
0:00	36.08	49.74	30.67	40.36
1:00	34.2	53.72	30.13	36.05
2:00	31.55	49.45	29.1	33.61
3:00	30.04	46.58	27.36	31.55
4:00	29.01	54.08	26.08	29.99
5:00	36.6	47.34	34.34	40.26
6:00	37.97	53.22	34.34	42.11
7:00	40.04	52.48	36.55	44.24
8:00	42.06	55.23	38.76	45.41
9:00	47.61	62.12	46.66	50.24
10:00	43.99	56.76	41.73	48.2
11:00	42.59	58.92	40.65	45.1
12:00	43.1	61.61	40.18	46.28
13:00	42.73	62.4	39.22	45.57
14:00	45.83	66.4	41.09	47.61
15:00	42.66	59.18	40.9	45.03
16:00	45.59	69.36	39.04	44.64
17:00	43.08	58.89	39.44	46.09
18:00	44.94	57.7	39.96	49.21
19:00	41.39	56.2	39.7	44.11
20:00	45.25	73.65	39.7	44.54
21:00	48.47	78.18	37.61	43.86
22:00	43.57	76.29	35.96	42.85
23:00	37.29	58.12	33.01	40.23

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	48.5	40.0	44.6	43.6	29.0	37.3
Lmax (Maximum)	78.2	52.5	61.9	76.3	46.6	54.3
L50 (Median)	46.7	36.6	40.1	36.0	26.1	31.2
L8	50.2	43.9	46.0	42.9	30.0	37.4

Computed Ldn, dB	45.8
% Daytime Energy	90%
% Nighttime Energy	10%

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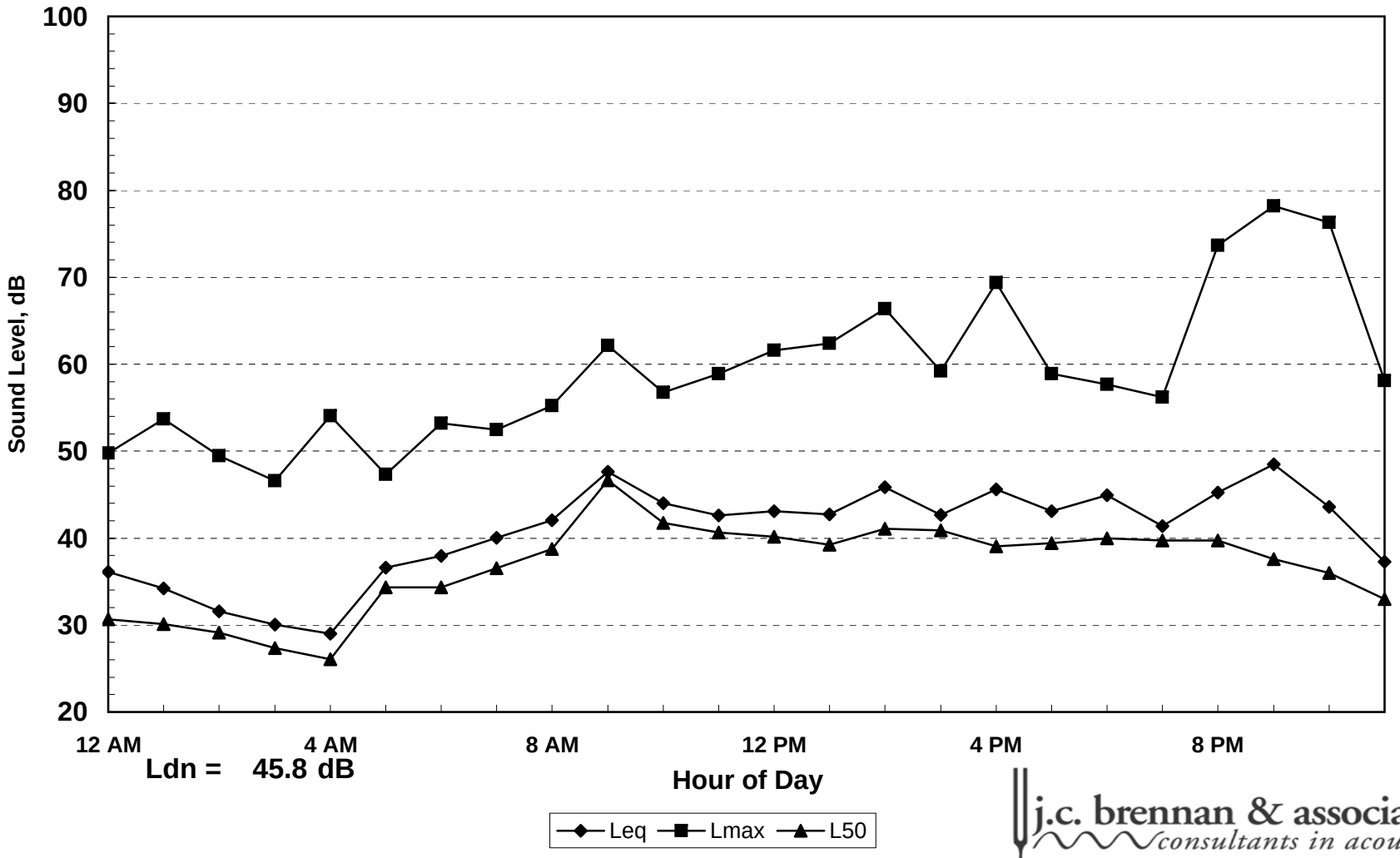
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-4

Saturday, April 30, 2011



Ldn = 45.8 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-4
Sunday, May 01, 2011

Hour	Leq	Lmax	L50	L8
0:00	34.98	51.15	31.17	38.33
1:00	33.15	53.84	29.88	35.96
2:00	32.6	49.57	29.97	34.21
3:00	29.33	43.69	28.27	30.93
4:00	30.92	44.05	29.44	32.45
5:00	43.17	55.79	39.08	48.52
6:00	39.89	51.92	37.61	43.36
7:00	41.33	56.81	39.14	44.16
8:00	43.93	58.82	39.66	48.65
9:00	45.19	66.35	40.18	47.24
10:00	44.99	57	41.35	49.31
11:00	47.24	65.26	45.8	49.56
12:00	42.76	60.36	39.72	45.24
13:00	42.8	60.57	39.86	45.71
14:00	44.13	58.39	42.5	46.56
15:00	44.57	61.18	41.83	46.27
16:00	46.69	61.93	43.29	49.67
17:00	41.55	59.04	37.99	44.21
18:00	42.24	63.97	38.6	44.44
19:00	45.92	62.99	44.87	48.93
20:00	43.96	57.31	40.19	48.5
21:00	43.98	61.9	39.86	48.3
22:00	42.78	55.2	36.89	48.32
23:00	37.6	60.52	33.96	39.85

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	47.2	41.3	44.4	43.2	29.3	38.5
Lmax (Maximum)	66.4	56.8	60.8	60.5	43.7	51.7
L50 (Median)	45.8	38.0	41.0	39.1	28.3	32.9
L8	49.7	44.2	47.1	48.5	30.9	39.1

Computed Ldn, dB	46.4
% Daytime Energy	87%
% Nighttime Energy	13%

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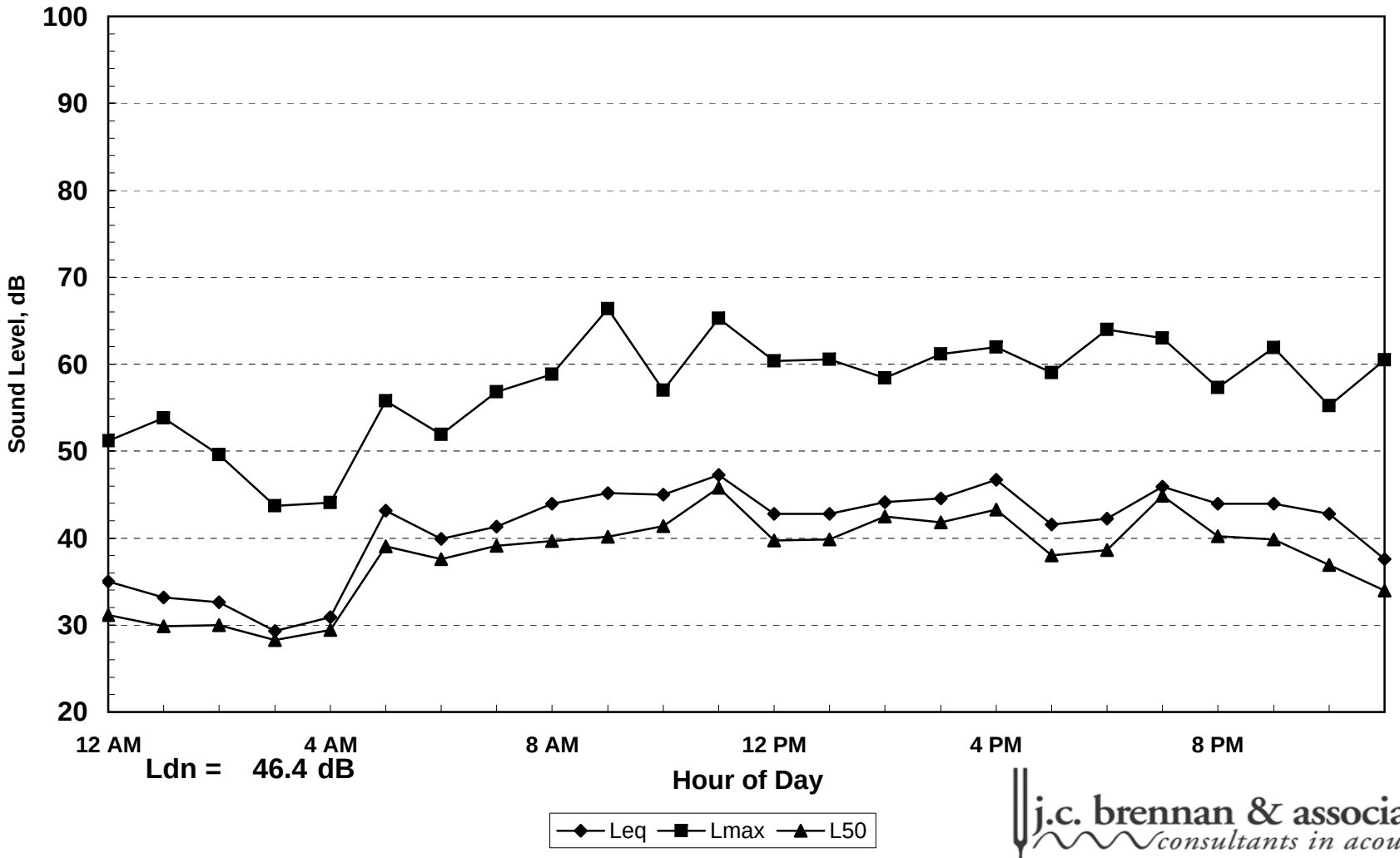
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-4

Sunday, May 01, 2011



Ldn = 46.4 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-4
Monday, May 02, 2011

Hour	Leq	Lmax	L50	L8
0:00	34.52	51.77	30.49	37.15
1:00	29.04	45.15	26.81	31.21
2:00	28.65	43.65	26.68	31.19
3:00	32.27	49.02	28.09	32.78
4:00	44.18	56.27	32.55	48
5:00	42.34	51.28	37.17	47.89
6:00	41.29	54.53	37.68	44.88
7:00	44.51	60.79	42.33	47.29
8:00	48.1	60.15	46.33	51.22
9:00	45.79	56.91	44.82	48.68
10:00	47.72	61.91	45.46	50.71
11:00	46.05	61.16	44.47	48.4
12:00	49.9	65.79	48.53	51.85
13:00	45.91	64.03	43.79	47.9
14:00	47.53	66.79	45.01	50.21
15:00	47.34	59.42	45.51	50.12
16:00	46.32	64.17	43.14	47.76
17:00	45.32	61.18	43.4	48.86
18:00	46.76	59.74	45.65	49.57
19:00	47.22	56.33	45.27	50.34
20:00	43.24	56.07	41.52	45.89
21:00	39.81	53.89	38.14	42.96
22:00	41.66	52.63	40.72	44.36
23:00	42.25	60.86	40.34	44.62

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	49.9	39.8	46.6	44.2	28.7	40.2
Lmax (Maximum)	66.8	53.9	60.6	60.9	43.7	51.7
L50 (Median)	48.5	38.1	44.2	40.7	26.7	33.4
L8	51.9	43.0	48.8	48.0	31.2	40.2

Computed Ldn, dB	48.3
% Daytime Energy	88%
% Nighttime Energy	12%

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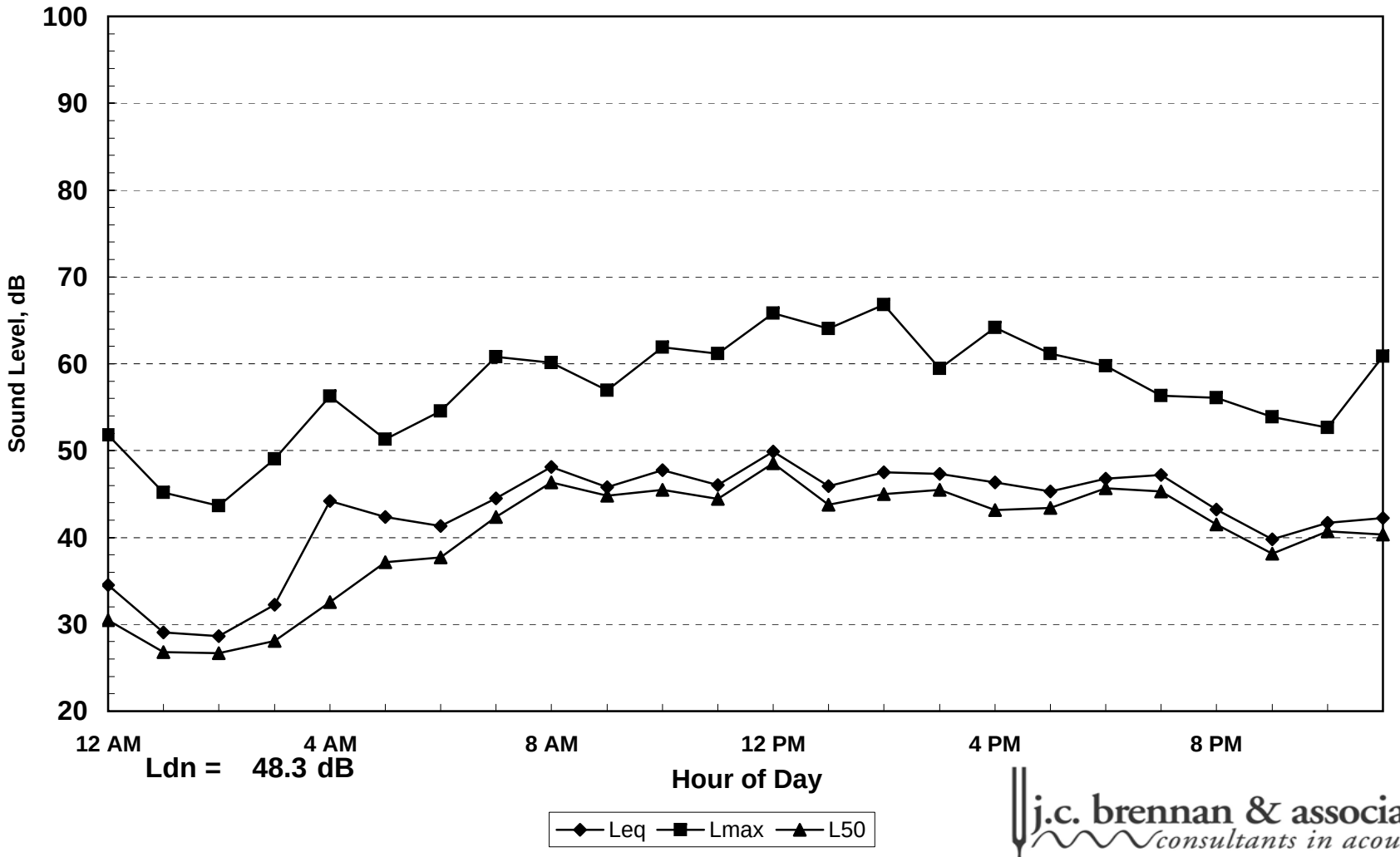
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-4

Monday, May 02, 2011



Ldn = 48.3 dB

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Appendix B
Lummi Wind Study
24hr Continuous Noise Monitoring - Site LT-4
Tuesday, May 03, 2011

Hour	Leq	Lmax	L50	L8
0:00	38.13	52.23	35.54	39.89
1:00	35.15	52.68	34.01	36.94
2:00	36.5	46.98	35.11	39.51
3:00	34.53	47.35	33.52	36.72
4:00	34.01	45.97	32.73	35.83
5:00	44.13	54.97	39.38	49.26
6:00	41.69	56.33	38.77	44.81
7:00	44.66	59.96	42.11	47.86
8:00	46.08	60.76	42.06	49.94
9:00	47.08	63.01	42.65	49.79
10:00	44.51	61.39	40.4	48.06
11:00	44.86	63.84	39.96	46.32
12:00	45.67	64.76	39.3	47.35
13:00	44.38	65.62	40.43	46.57
14:00	47.06	63.14	42.68	50.1
15:00	47.73	66.86	43.86	49.8
16:00	49.34	65.85	48.54	51.58
17:00	44.52	56.18	42.82	47.84
18:00	42.19	59.19	40.29	45.01
19:00	46.04	62.23	42.24	49.38
20:00	49.5	61.57	42.84	55.28
21:00	51.67	70.11	38.9	56.83
22:00	37.72	53.07	34.58	40.96
23:00	36.61	52.64	33.02	38.86

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	51.7	42.2	47.1	44.1	34.0	39.0
Lmax (Maximum)	70.1	56.2	63.0	56.3	46.0	51.4
L50 (Median)	48.5	38.9	41.9	39.4	32.7	35.2
L8	56.8	45.0	49.4	49.3	35.8	40.3

Computed Ldn, dB	47.9
% Daytime Energy	91%
% Nighttime Energy	9%

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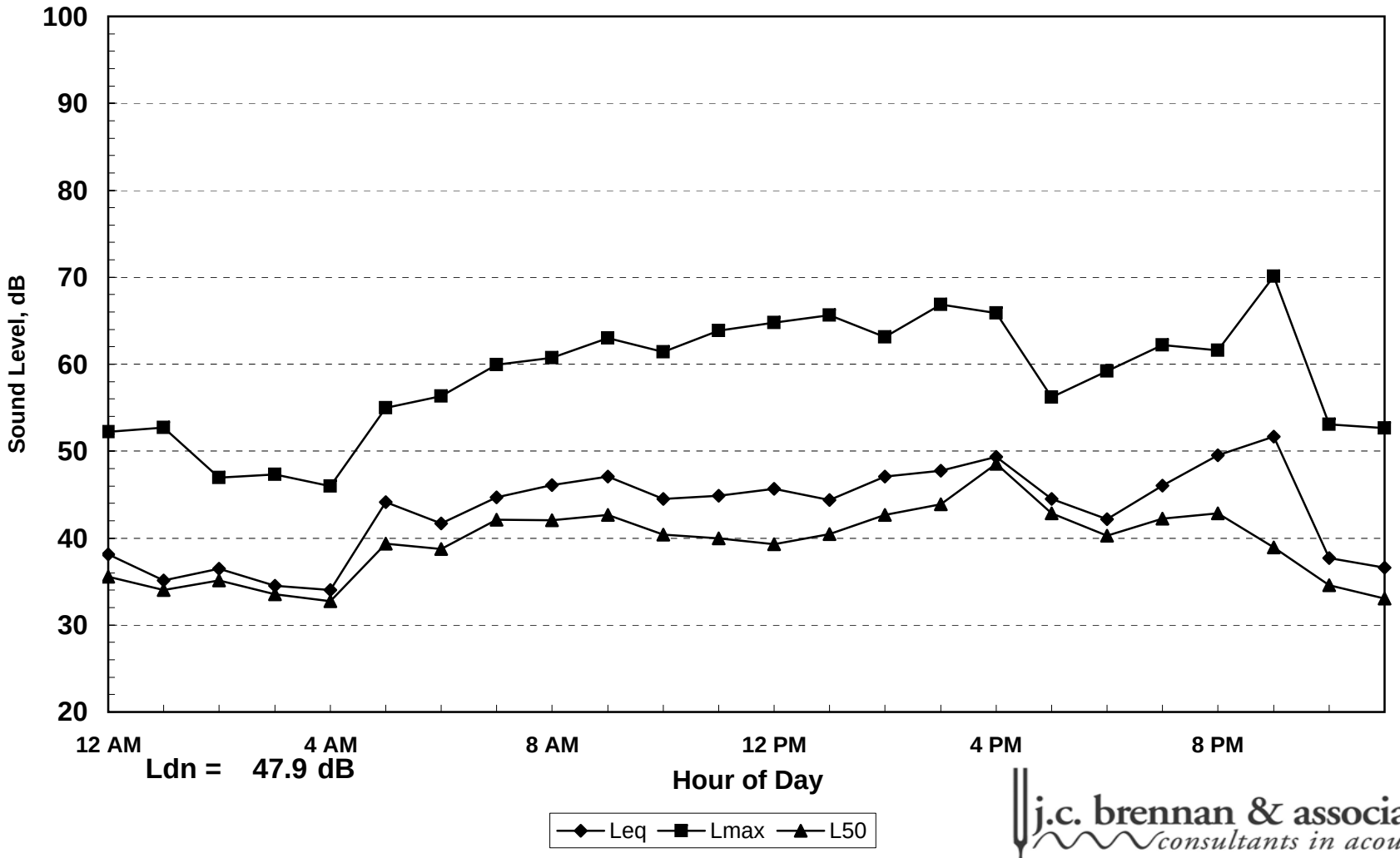
Appendix B

Lummi Wind Study

24hr Continuous Noise Monitoring - Site LT-4

Tuesday, May 03, 2011



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